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MANCHURIAN RICE GRASS (*ZIZANIA LATIFOLIA*).

ITS OCCURRENCE AND DISTRIBUTION IN THE NORTHERN WAIROA DISTRICT.

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WHEN numerous ships were engaged in transporting from North Auckland the large quantities of both white-pine and kauri timber, many arrived in ballast, which usually consisted of soil loaded at the last port where cargo was discharged. On arrival in the Northern Wairoa, the ballast was indiscriminately dumped along the banks of the river. From such ballast dumps, deposited from a ship which, according to early settlers, arrived from South Africa some thirty or forty years ago there spread and naturalized itself along the river-banks an exotic plant. This plant is called locally jungle grass, South African grass, reed-grass, rice-grass, or elephant grass. Recently, owing to its spread along the soft mud of the tidal-river banks, following up and blocking watercourses and drains, gradually working its way into damp or swampy places, and slowly encroaching on flat pasture land bordering the Northern Wairoa River, it has caused concern among the farmers whose land is adjacent to the river-banks. This plant has been identified by Allan(1) as Manchurian wild rice (*Zizania latifolia*), and is a native of Asia. He further states that in China the thickened bases of the stems are sold as a vegetable, and are said to have a fine flavour.

Manchurian wild rice is a very tall-growing grass, with the stems and leaves reaching a height of from 6 ft. to 10 ft. It possesses a strong deep rooting-system and far-reaching rhizomes. In the soft river-banks the thick roots penetrate several feet into the soil. It also has the undesirable habit of sending roots and rhizomes down under drains and trenches which have been dug to prevent its spread, and throws up suckers or new plants on the other side of the trench. In some places it is found growing on the roadway, the suckers having broken through 10 in. to 12 in. of road-formation. During the winter little or no growth occurs. The old leaves, particularly where exposed to severe winds, begin to die off, but the remainder of the plant remains fresh and green. About September fresh green growth is produced throughout the area of the grass, and, if soil conditions are wet enough, new shoots from rhizomes are given off for a distance of usually up to 3 ft. on the land side of the affected area. However, the extent of

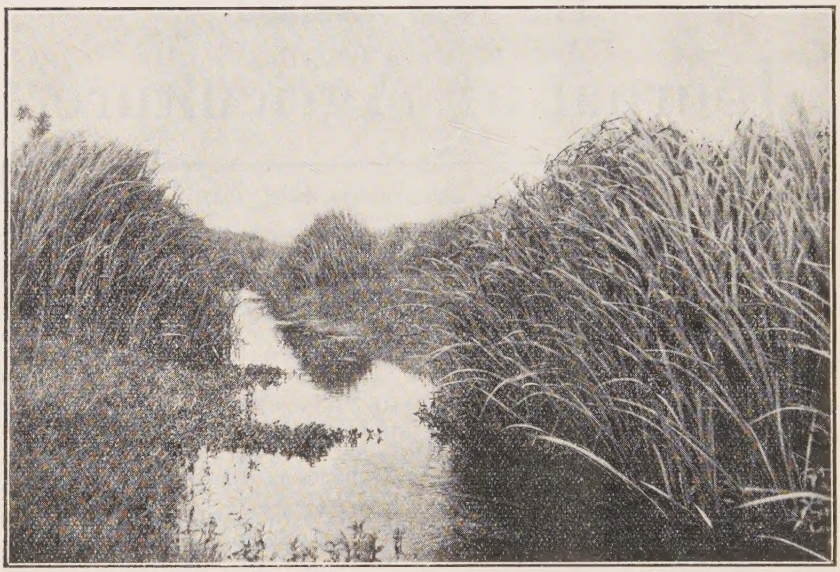

FIG. 1. MANCHURIAN WILD-RICE GRASS (ZIZANIA LATIFOLIA), GROWING ON BOTH SIDES OF A DRAIN AT ARATAPU.

In some cases the grass will form a complete belt on each side and eventually block the drain.

FIG. 2. CLUMPS OF MANCHURIAN WILD-RICE GRASS SPREADING INTO SOFT WET PLACES IN A FIELD.

Note small plant in the foreground. This has suckered from the large patch on the left. The photograph was taken near the drain shown in Fig. 1.

spread along the softer river-bank is considerably greater. During late November or early December, flowering-stalks, which carry in a panicle the female flowers above and male flowers below, are sent up within 8 ft. to 10 ft. of the outside wall of the grass. The plant is an irregular seeder, but in some seasons quite a fair amount of seed has been produced. When ripe the seed falls and is carried both up and down the river by the regular rise and fall of the tide. If floods occur, the seed may be deposited on pasture land, where it quickly germinates, and new centres of growth are established. From single plants derived from seed or portions broken away from established plants, the grass spreads to other areas along the river previously free of Manchurian rice-grass. At Hoanga there is a patch of approximately 1½ square chains, which has during the last fifteen years, despite several cuttings and burnings-off, spread from a single plant. On the opposite side of the river at Awakino Point rice-grass has encroached over a stop-bank, under and across a drain and out into a field, apart from the stop-bank and drain, a distance of 21 ft. in the past four or five years. In general, however, the spread inland may not exceed 2 ft. or 3 ft. each year. By such methods, from the various centres of establishment, the patches grow into continuous belts, which in some cases are up to 2 chains in width along the river and creek banks.

The Manchurian rice-grass extends over a distance of some twenty-five miles along the banks of the Northern Wairoa River. Small areas occur up the Naumai Creek, and from there, up the Northern Wairoa River, intermittent patches are present on both banks to within a few miles past Tokatoka. From there, particularly on the western bank, more or less continuous belts up to 2 chains in width occur. It has penetrated varying distances up side creeks and drains. It exists over approximately one mile along the banks of the Aratapu Stream, and belts of differing sizes are to be found for a distance of four and a half miles up the Kaihu River. The widest belts are found about half a mile above the bridge at Dargaville, round Awakino Point, and on the opposite banks at Hoanga. From there up the river it grows in belts and areas of varying sizes to within a short distance of Pukehuia.

Several factors appear to influence the rate of spread of Manchurian wild-rice grass. As the tidal effect becomes less in the river, the grass is stronger-growing, encroaches more rapidly on to good land, and causes more trouble through affecting stop-banks and blocking entrances to drains. Shade trees inhibit the growth and spread. On one farm, where such trees (pines) were planted some twenty or thirty years ago, there occurs a break in what is otherwise a continuous belt of rice-grass. Further, in some places, belts of New Zealand flax growing between the stop-banks and the water tend to hinder its spread into good grass paddocks. On farms where English grasses are in combination with paspalum, and where ample winter feed is provided by means of hay and silage, and also on partly drained farms with much roughage where stocking is not heavy, this grass is left alone by stock. However, on farms where winter feed is short or lacking stock will eat a small proportion of the shorter outside growth, and thus maintain some check on its spread. Here the grazing animals not only eat back the younger growth and tips of the longer, coarser, unpalatable leaves, but also make tracks through the grass areas and derive a considerable amount of shelter during the winter and early spring months when cold westerly

or south-westerly winds are common. Otherwise stock do not have a liking for the grass. It also appears that Manchurian rice-grass will not stand tramping by stock to any great extent. This would be effective only on the drier land, and not on the river side of stop-banks or on undrained areas.

As mentioned before, the slow insidious encroachment of rice-grass on to the good land is causing considerable concern and attention among farmers. Some do not give it much thought, and have a good word for it. These men are inclined to value it as a shelter for stock during the winter and early spring, and also claim that it assists to hold the stop-banks together. However, during an

FIG. 3. A BELT OF MANCHURIAN WILD-RICE GRASS ENCROACHING INTO A FIELD AT AWAKINO POINT.

The grass has spread from the river-bank on to the stop-bank over a drain and through the fence out into the pasture.

investigation, in some instances, it was found that where the grass grows densely along stop-banks, the formation, instead of remaining firm, has now become a mass of soft mud which does not dry out and then slowly flattens out to be washed away by the tidal current. Where it only possesses a strip of the river-bank, and conditions do not allow of its spread inland, it is no doubt valued as a winter feed for dry stock, especially bulls and yearlings. Here little or no winter supplementary feed is available, and its value arises through poor farming methods. Where the grass does cause trouble, interfering with the efficient working of drainage systems and encroaching into pastures, may methods of control and eradication have been attempted. Burning during dry spells was no doubt the method which most readily recommended itself. Even if what might be called a good "burn" occurred there was always 2 ft.

or 3 ft. of the more open and shorter growth left unburnt round the outside. The face of the area was left free to extend, while fresh vigorous growth soon commenced over the burnt area. Use of the flame-thrower has been made. The first burning requires considerable treatment, and, as in the case of ordinary burning, the regrowth is very rapid. Further treatments of the regrowth will probably be necessary, thus making a control which is of questionable value, expensive, and not likely to be really effective for general adoption. Cutting, particularly in the soft mud is difficult and costly. Further, it appears to only prune the plants, which recommence growth with renewed vigour. Some farmers who cut small areas utilize the bundles of leaves for laying in roadways which become muddy through continual traffic of stock. This assists for a short time, but produces odours which are objectionable, especially if the filling is near a milking-shed. In other cases the long leaves are cut and used for the thatching of haystacks. The leaves being long and bulky are much more easily and quickly built on to a stack than are ordinary rushes. The rain-water is readily shed and the thatch lasts until the stack is utilized.

Taking into account the nature and spread of Manchurian rice-grass, as well as the fact that the more common methods of control have failed, the position really becomes most difficult. Eradication does not appear to be possible. Control of the present areas, together with the prevention of its further spread, must therefore be the consideration. The suggestion which offers itself is to make some attempt to confine the grass to those areas upon which it is growing at present. This would necessitate the planting of suitable evergreen shade trees, 5 ft. or 6 ft. inside of the present line of the grass. Trees tolerant of wet conditions would have to be selected. Fencing would be necessary. This, together with the land abandoned as useless, and the area occupied by the shade trees, would make the control expensive. If flood-water causes fresh centres of the grass to be established inside the line of trees, these new plants should then be immediately treated by spading, or by cutting and maintaining the growth constantly at a stage to be eaten by stock. Except for small areas, such as the outlets of drains, chemical methods of treatment are to be considered a waste of time.

(1) ALLAN, H. H.: An Introduction to the Grasses of New Zealand. Bulletin No. 49, Dept. of Scientific and Industrial Research.

The necessity of sowing fertilizer with turnips is well illustrated in the four turnip-manuring trials in the Christchurch district. In each trial one or two drill strips were sown without manure, and these plots are less than one-third as well grown as plots which received super and lime (4 cwt. per acre), reverted super (249 lb. per acre), super and blood and bone (2 cwt. per acre), or proprietary manure (2 cwt. per acre).

—*Fields Division.*

In a paddock of rape in Eastern Southland part of the crop was sown broadcast and part of it was sown in ridges. The crop on the broadcast section is poor and stunted, while that on the ridged section is good and vigorous. The quantity of fertilizer applied was the same on both blocks, but the scuffling and inter-cultivation on the ridged rape has made the comparative differences.

—*Fields Division.*

THE AVOCADO.

CULTURE IN NEW ZEALAND.

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THE avocado is a tropical or semitropical fruit that was little known in temperate zones until a quarter of a century ago. Since that time rapid progress has been made in the cultivation of this fruit in temperate climates. The name "avocado" is now applied to this fruit in all English-speaking countries, while in certain foreign countries the fruit is known as the "alligator pear."

INTRODUCTION TO NEW ZEALAND.

So far as can be ascertained, the first avocado-trees of known varieties to become established in New Zealand were imported by the Department of Agriculture in the year 1919, and were planted in what was then the Government Horticultural Station at Tauranga, which is located in latitude 38° S. In later years numerous trees were raised from seeds which were imported, and a few of these trees are now bearing fruit. Many other trees have been raised from the seeds of one of the trees at Tauranga, which commenced to bear fruit at an early age. In addition to the foregoing, trees comprising thirteen different named varieties were imported and established at Wanganui.

DESCRIPTION.

The avocado belongs to the genus *Persea*, a member of the Laurel family, to which belong also such economic plants as camphor and cinnamon. The cultivated species of the genus are native of Mexico and Central and South America. They are divided into two distinct species,* *P. americana* and *P. drymifolia;* the former includes all varieties horticulturally grouped in the West Indian and Guatemalan races, and is commonly known as the Guatemalan species. *P. drymifolia*, known as the Mexican species, includes the small-fruited varieties of the Mexican highlands. Both species are represented in the cultivated varieties. The Mexican species can be distinguished from the Guatemalan by the very pronounced anise odour that can be detected in the leaves and young growth of the former when crushed; this odour is entirely lacking in the Guatemalan species.

The tree is evergreen and has a spreading habit, the height usually approximating the spread. The largest tree in New Zealand is reported to have attained a height of 35 ft. Seedling trees are inclined to be more upright than when budded. The leaves may be oval, elliptic, or lanceolate; their base is usually acute or truncate; the apex varies from blunt or acuminate; the length is reported (Hodgson) to vary from 3 in. to 15 in., but, as observed in New Zealand, is approximately 6 in. to 8 in. The colour is bright green; young growth is generally bronze.

* R. W. Hodgson, Associate Professor of Subtropical Horticulture, University of California. "Californian Avacado Industry." Circular No. 43 (April, 1930). Issued by the Californian Agricultural Extension Service.

The flowers are small and usually of a yellowish colour. They are borne on terminal racemes, possessing both stamens and pistil. Various reports from overseas authorities indicate that the fruit of the cultivated species are extremely variable in size, shape, colour, and other characteristics, varying in size up to over 3 lb. In shape they may be round, oval, pyriform, or any of the numerous gradations between these forms. The colour ranges from light yellowish-green, through dark green, maroon, brown, and reddish-brown, to purplish-black. The skin is thin and membranous in *P. drymifolia*, while in *P. americana* it is thick and tough, varying greatly in different varieties.

The fleshy, edible part, lying between the skin and the seed, is of a buttery consistency, cream to bright yellow in colour, often greenish near the skin. Each fruit normally contains a single large seed. The seed is inverted in the fruit so that the base is on the side away from the stem. Most, if not all, of the fruits produced in New Zealand are pyriform or between pyriform and oval in shape and vary in length from about $2\frac{1}{2}$ in. to $5\frac{1}{2}$ in., with a maximum diameter of approximately $3\frac{1}{4}$ in.

This savoury fruit has a nut-like flavour, and is most commonly used either as a green salad ingredient or, when mashed and seasoned, as a sandwich filling. It can also be served on plain biscuits or on toast.

Nutritive and Dietetic Values.

The composition of the avocado is remarkably different from other fruits used in the fresh state. It has been shown by various overseas workers (R. W. Hodgson) that its average protein content (2·1 per cent.) is approximately three times that of the ordinary fresh fruits. Whereas most fruits contain little or no fat, the average in the avocado is 20·6 per cent. The caloric or energy value of the edible portions of the commonly used fruits is low, ranging from a minimum of 175 calories to a possible maximum of 400 calories per pound. The average for the avocado, as determined by Jaffa and Goss, is 1,056 per pound, or two and a half times the maximum for the other fruits, and far in excess of that of lean meat. From these facts it is evident that this fruit contains nutritive values far exceeding those of other fresh fruits.

Climatic and Soil Requirements.

The cultivated varieties of the avocado are subtropical fruits, and their culture is therefore limited to localities of relatively mild winters, such as are experienced in the warmer coastal regions of the Auckland Province. Observations on the behaviour of the avocado in New Zealand, supported by evidence from overseas countries, indicates that it will thrive on a wide range of soils. The character of the subsoil is perhaps of the greater importance, since perfect drainage and an absence of impervious clay or hard pan for a depth of 3 ft. or more appears to be imperative. Evidence in support of this belief lies in the fact that several dozen seedling trees planted near Warkworth over an impervious clay subsoil

all failed to develop into mature trees. In general it can be taken that for the varieties of avocado generally cultivated the climatic and soil requirements are somewhat similar to those of citrus fruits.

Propagation.

Like most other fruits, the avocado cannot be depended upon to reproduce true to type when raised from seed. Consequently, stocks are raised from seeds of hardy varieties, and when of sufficient size these are budded in the same way as citrus trees. While the operation of budding is a simple one, the results obtained are often disappointing, in that frequently many buds fail to take, even when the work is done by an expert operator.

Particulars of Trees growing in New Zealand.

The four trees established at Tauranga, referred to earlier in this article, were planted in the year 1919. They consist of one tree each of the following four varieties: Lyon, Northrop, Harmon Abouacate, and Miserve.

Lyon.—This tree commenced cropping four or five years after planting, and has borne light to medium crops almost every year since that date. The tree is now about 35 ft. high. The fruit is small, weighing about 3 oz. to 4 oz. The seed is relatively large, and the flavour does not compare favourably with other varieties grown in New Zealand.

The other three varieties growing at Tauranga have blossomed profusely for many years past, but have never set any fruit. The variety Miserve is the only tree to be affected at all seriously by frosts, and consequently is much smaller than the other three trees.

Fuerte.—The only tree of this variety known to the writer is in a private garden at Feilding. The tree was budded on to a seedling stock, where it now grows, seven years ago. It has a height of 16 ft. and a spread of 10 ft. The tree has flowered profusely for several seasons past, but no fruit has set to date, unless during the present season.

Two trees of unnamed varieties were imported from Honolulu in the year 1929 and planted at Kerikeri, North Auckland. They attained a height of 14 ft. four years from planting. The trees were then cut back severely for the purpose of shifting to another position. They made a good recovery, and are now 9 ft. in height. No fruit has yet been produced.

Numerous seedlings of the Lyon variety have been distributed from Tauranga to various parts of the North Island. Most of these seedlings have met with little success, many having died a few years after planting. However, two of these trees, which are situated at Thames and are now ten years old, have in recent years commenced to bear fruit.

Two avocado-trees in New Zealand which have borne fruit, other than the Lyon variety, are in a commercial orchard at Ormond, near Gisborne. In this orchard there are four trees that were raised about twelve years ago from seeds imported from California, and of unknown variety. These trees have all made vigorous growth, and have never suffered to any appreciable extent from frost injury. One tree (hereafter referred to as No. 1) commenced to bear fruit eight years after planting, and another (No. 2) one year later. The other two trees have flowered profusely for several seasons without setting any fruit. The

soil in this orchard is a fertile clay loam, with good natural drainage. Another tree raised from the same consignment of seed is situated in a narrow valley about ten miles inland from Tolaga Bay, and has made poor progress on account of severe frost injury on numerous occasions.

Tree No. 1.—This tree is now bearing its fifth successive crop, the two heaviest crops being estimated at between fifty and eighty fruits. Most of the fruits matured to a suitable size for commercial use, being approximately 5 in. long with a diameter of $2\frac{3}{4}$ in., and pyriform in shape. The flavour is rich and aromatic; the seed is relatively small with a close-fitting seed cavity; and the colour of the skin when fully ripe is purplish-black. The harvesting period extends from the first week in October until the end of the year, and possibly later.

Tree No. 2.—During the 1933–34 season this tree brought to maturity some forty fruits, and only a few fruits in both the two previous seasons. It is slightly larger than and of a similar flavour and colour to the fruit borne on tree No. 1. The seed is relatively small, and the seed cavity close-fitting. The shape is between pyriform and oval. The season of ripening is not known exactly. However, fruits have been harvested in good marketable condition from early January until the end of August. The fruit of this tree is about three months later in reaching maturity than tree No. 1.

Tree No. 1 corresponds very closely with the description of the Fuerte variety (as supplied by R. W. Hodgson), and is probably a seedling of that most popular variety. Likewise, tree No. 2 is similar to the description given of the Puebla variety, and so is in all probability a Puebla seedling. These two varieties are reported to be planted for commercial purposes in the United States of America more extensively than any other varieties.

The trees of thirteen named varieties were imported by the late Mr. A. Allison and established in his garden at Wanganui. Most of these trees were introduced in 1925 and in 1927, although several years earlier he had raised a number of seedlings, and at least one tree was successfully budded with the Fuerte variety in 1923. In 1931 this excellent collection of varieties was reported to be making vigorous growth, very few trees showing any appreciable injury from frost. Varieties that flowered in the 1930 season were Fuerte, Puebla, and Northrop. So far as can be ascertained, none of these varieties set fruit. Following the death of Mr. Allison, the entire collection was sold by auction, buyers participating from various parts of the North Island. No further record of these trees is available.

A nurseryman reports having grown avocado-trees at New Plymouth which flowered for a number of seasons, but failed to set any fruit, and were later destroyed. It is not known whether these were seedlings or propagated trees of named varieties. It is also reported that seedling trees of the Mexican strain have been grown at a station on the Wanganui River for the past twenty-five years. Some of these trees have fruited, but the quality is said to be poor.

Possibilities.

From the foregoing it appears that, while the trees of many varieties will withstand the winter temperatures experienced at least as far south as Feilding, latitude 40° S., it is only in the milder coastal areas of the Auckland Province that fruit can be expected to develop

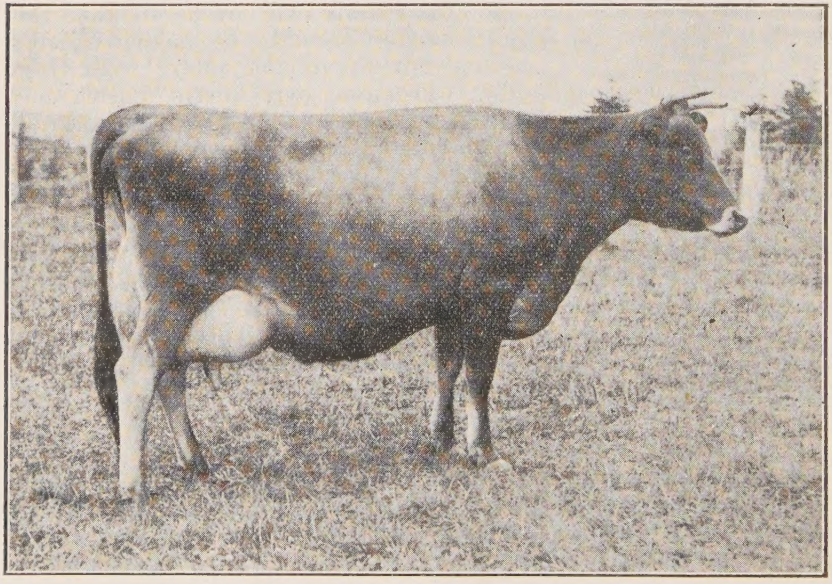
on varieties suitable for cultivation. Moderate crops have been reported from Thames, Tauranga (latitude 38° S.), and Gisborne (39° S.). The only named varieties known to have been tried out in such warm areas are at Tauranga, and these, unfortunately, do not include the leading commercial varieties. The fruit is practically unknown in New Zealand at the present time, although small consignments are occasionally imported from California and the Pacific Islands. These fruits usually retail at prices ranging from 6d. to 1s. 6d. each according to quality.

It appears that there are commercial possibilities in the growing of this fruit in suitable localities in the northern portion of the North Island of New Zealand. However, there is need for much more work in the matter of testing the suitability of various varieties, soils, and locations before planting on an extensive scale is undertaken.

The writer wishes to express appreciation for the valuable information concerning avocado-trees in New Zealand kindly supplied by the following Orchard Instructors: Messrs. A. R. Grainger, Tauranga; L. Paynter, Auckland; and J. W. Whelan, Palmerston North. Also the late Mr. H. F. Frost, formerly Orchard Instructor, Masterton.

CERTIFICATE OF RECORD.

THE Jersey cow Pukeroa Wheaten Wafer, bred and tested by Mr. F. Geck, Te Kauwhata, recently qualified for Certificate-of-Record in the 305-day division of the C.O.R. test on a production of 12,853·9 lb. milk containing 700·76 lb. fat, average test 5·45 per cent. She was 3 years 165 days old at date of calving for commencement of record, being born on 3rd September, 1932. The performance of Pukeroa Wheaten Wafer is the highest to date in the 305-day class, not only for the Jersey breed, but for all breeds participating in the C.O.R. test.



PUKEROA WHEATEN WAFER.

[*N.Z. Farmer Weekly photo.*

IRRIGATION IN CENTRAL OTAGO.

DUTY OF WATER.

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"DUTY of water" is the term used in defining the total amount of irrigation water used on the land to produce successfully any given crop. The duty of water is said to be high or low depending on the amount of water used. On a given soil type and crop a high duty of water is obtained under careful and efficient management or a low duty of water under careless and wasteful management where the consumption of water has increased.

FIG. 1. THE CROP OF UP-TO-DATE POTATOES GROWING ON THE LIGHT SANDY LOAM UNDER IRRIGATION AT ALEXANDRA.

Since so many factors come into play when determining duty of water it is impossible to lay down any hard and fast rules regarding it. Apart from the different requirements of different crops there are large variations in the water-holding capacity of the soils and subsoils themselves.

It has been shown(1) that soils composed of fine particles—*i.e.*, clays and silts—can absorb and hold a definitely greater volume of water than soils composed of coarser particles such as fine gravels and sand. Consequently the latter type requires more frequent but smaller irrigations than the former. Further, the depth of soil, presence of a hard pan or an open gravel subsoil all necessitate using different amounts of water when irrigating to obtain a high duty of water.

With a good depth of soil a large volume of water can be used and the surface soil saturated: there is a downward movement of water, which, however, rises again by capillary action after the moisture near the

surface has been used. Where a pan is present smaller quantities of water must be used, otherwise one gets water-logged conditions of the soil. A gravel subsoil, while supplying ideal conditions for drainage, is also a natural sink into which all excess irrigation water is lost, as there is no return movement of this water by capillary action. Consequently, to get a high duty of water here, only sufficient irrigation water should be used to meet the current requirements of the crop or the water-holding capacity of the soil without penetrating into the shingly subsoil. In a previous article(2) the low duty of water is seen on the 52-acre farm mainly due to the fact that the shingly subsoil reaches, or is in close proximity to, the surface over a comparatively large area of the farm.

Evaporation from a wet-soil surface is much faster than from a free-water surface. The average loss from a free-water surface at Alexandra for the period of three years—1933, 1934, and 1935—is 31·7 in. per annum. Since a loss such as this is often as much as and sometimes more than the irrigation water applied to the land, some measure must be taken to conserve the irrigation water. A cereal, grass, or lucerne crop supplies a natural cover to stop excessive evaporation, but when a crop, such as potatoes, mangel, maize, or carrots is grown in drills, then the soil requires mulching. This mulching or loosening-up of the surface can be done with a cultivator or horse hoe: it retards the capillary movement of the moisture to the surface and to a large extent checks evaporation. At Galloway Experimental Area(3) it was found that where the ground had not received cultivation till eight days after irrigating the water lost by evaporation was in the vicinity of 2 in. On adjacent ground where surface cultivation had been carried out after irrigation the loss amounted in eight days to ½ in.

The size of the total irrigated holding is reflected in the duty of water. As shown in the previous article referred to(2), a small area can be irrigated more economically than a large one, provided the soil type is the same, inasmuch that a smaller head of water is required and the work of distribution can be carried out more effectively.

The system of irrigation used is also a big factor in determining whether the duty of water will be high or low, since some systems are more efficient than others.

Rainfall for Six-monthly Period, October to March at Alexandra.

As can be seen from the following data, the average rainfall for each wet day was so light at Alexandra during the period specified as to be of practically no value to the land:—

Season.	Rainfall.	Number of Wet Days.	Average Rainfall per Wet Day.	Annual Rainfall for Year ending 31st March.
	Inches.		Inches.	Inches.
1934–35 ..	7·43	45	0·16	14·25
1935–36 ..	5·16	51	0·10	9·28

The following table represents actual figures taken out on the duty of water over the past two seasons within a radius of five miles of Alexandra:—

Crop.	Soil Type.	Area in Acres.	Method of Irrigation.	Number of Irrigations.	Volume of Water used for Irrigation.	Total Water used, in Inches per Acre.	Yield per Acre.	Duty of Water per Ton.
						Inches.		Inches.
1. King Edward potatoes	Medium to heavy schist loam	4·0	Furrow ..	4	2 cusecs for 24 hours	47·5	13 tons ..	3·6
2. King Edward potatoes	Medium to heavy schist loam	1·8	Furrow ..	4	1½ cusecs for 24 hours	78·64	17·07 tons ..	4·6
3. Epicure potatoes ..	Light sandy loam ..	0·329	Furrow ..	5	½ cusec for 8 hours	60·0	6·5 tons ..	9·2
4. Up to Date potatoes	Light sandy loam ..	..	Furrow ..	5	½ cusec for 8 hours	60·0	8·75 tons ..	6·85
5. Millet	Medium schist loam ..	2·5	Flooding from contour race	2	1 cusec for 60 hours	47·52	Not available ..	..
6. Mangels	Heavy schist loam ..	2·74	Furrow ..	4	⅓ cusec for 36 hours	17·34	50·5 tons ..	0·34
7. Lucerne hay ..	Light shingly soil ..	3·0	Flooding from contour race	6	2 cusecs for 24 hours	95·0	18 tons hay ..	5·2
8. Lucerne hay ..	Medium schist loam ..	20·0	Border dyke ..	6	4 cusecs for 24 hours	28·51	5 tons silage and 3·3 tons hay	5·2
9. Lucerne hay ..	Light and shingly ..	10·0	Border dyke ..	6	5 cusecs for 24 hours	71·28	5 tons silage and 3·2 tons hay	5·2
10. Oats	Medium to light shingly loam	4·75	Flooding from contour race	3	1 cusec for 8 hours (once), 2 cusecs for 24 hours (twice)	21·6	1·25 tons chaff ..	17·2
11. Wheat	Medium to heavy schist loam	11·0	Flooding from contour races	1	2 cusecs for 72 hours	12·9	*40 bushels ..	0·32 (per bushel).

* Estimated yield was 40 bushels per acre. The crop was sown on 13th August, 1935, and was a mixture of Dreadnought, Hunters, Pearl, and Tuscan, and in the uneven ripening a fair proportion of the grain was shaken. Six weeks of steady frosts after sowing delayed germination and caused rotting of over 50 per cent. of the seed, thus producing rather a thin crop.

Potatoes.—Although the four potato crops are not strictly comparable, still they serve to demonstrate the variations that occur under irrigation. Crops Nos. 3 and 4 required an extra irrigation, due to the light soil type with a lower moisture-holding capacity. In the "Total water used" column crop No. 2, although on heavy land, has had the most water, but has made up for that fact by producing the heaviest

FIG. 2. THE MIXED WHEAT CROP WITH ESTIMATED YIELD OF 40 BUSHELS ON THE DUNSTAN FLAT.

FIG. 3. THE OAT CROP.

Note the good growth of red clover which was broadcast after the oats were sown.

yield, while in the "Duty of water per ton" column the figures appear reasonable when the soil types and yields are taken into consideration.

Lucerne Hay.—In crops Nos. 8 and 9 the first cut from these areas was made into silage, giving approximately 150 tons, the remaining three cuts were made into hay, and produced 96 tons. The "Total water used" gives a good indication of the soil type and its water-holding capacity for the three crops. The "Duty of water" figures for hay are not comparable, due to the production of silage.

Millet.—To the writer's knowledge this is the first season that millet has been grown in Central Otago, when four crops were grown. This season has demonstrated that millet can be successfully grown, and has a place in irrigation farming.

Oats.—Two irrigations of 2 cusecs were required during the growing-season, due to the light soil type. The irrigation of 1 cusec for eight hours was accidentally given when the water-race broke away, and only part of the area received this water.

Wheat, being on a better soil type than the oats, required only one irrigation, and a quantity of, say, 4 to 6 acre/inches of water may have been sufficient, but as there had not been enough rain to either consolidate the ground or cake the surface the soil was comparatively loose and free, and 4 in. to 6 in. of water could not have been spread over the paddock. It required 2 cusecs running for three days to cover the field.

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SMALL-FARM SETTLEMENT ON RECLAIMED TIDAL FLATS, WHANGAREI HARBOUR.

R. P. HILL, Fields Instructor, Auckland.

ON the shores of Whangarei Harbour there is an area of land known as Pohe Island reclamation. Some ten years ago the Whangarei Harbour Board erected stop-banks and dug some main drains(1). Three years later the Department of Agriculture carried out experiments in the grassing of a portion of this land, some 16 acres being made available for this purpose. More open drains were dug, and the land was also underdrained. In the underdraining narrow drains were scooped out with a draining-spade about 2 ft. 6 in. deep at intervals of 2 chains apart. These drains all led into the main drains, and reached right back into the area to be drained, and were later filled in with about 1 ft. of manuka, and finally covered with earth. By this means half the area was underdrained and half was not. In December, 1928, the land was ploughed and fallowed until March, 1929, when it was cultivated and laid down to pasture. The establishment of pastures was much more rapid on the underdrained portion, although grasses and clovers eventually established

(1) C. J. HAMBLYN: "Pasture Establishment on Reclaimed Tidal Flats. See this Journal, August, 1932.

on the undrained area and the general establishment was so encouraging that it was realized that this was land that could soon be expected to carry dairy herds.

The total area of Pohe Island is approximately 100 acres, the soil is not uniform, portions of it being a stiff mud clay, and the balance a mixture of sand and clay overlying beds of pipi shells, with small areas of a silty nature—with the exception of this latter type, none of these soils crack much when drained. The experimental grassing having been so encouraging, it was decided to proceed further with the work, using unemployed labour.

In December, 1932, under the Small Farms Board Scheme, Pohe Island reclamation was subdivided into four sections and settled with unemployed families by the Department of Agriculture. Cottages were erected for each settler, and further areas were ploughed and disked and grass-seed sown in March, 1933.

At present the settlers are paying their way, this including paying rent on the land and interest on the capital expended on the holding. It must be remembered that before settlers were eligible to occupy these holdings they had to show that they had no assets.

The settlers, once in occupation, ploughed and sowed down to pasture further areas of their sections, using the same seed-mixture as that used by the Department of Agriculture, until by now very little further grassing remains to be done. The land did not dry out uniformly, and consequently this meant that further small drains had to be laid by the settlers themselves before ploughing could be undertaken. On a small area which, when the time was ready for ploughing this year, was still too wet to plough, the following treatment was adopted: Hay was fed over the area, and the tramping of the hoofs of the cattle broke the surface of the soil; the settler later scattered more rye-grass and clover seed, and the whole is now showing an excellent strike of pasture. Splendid vegetable-gardens have been established and fruit-trees planted, which are now coming into bearing, and each man has also been kept busily employed erecting further subdivision fences, grubbing rushes where necessary, building bridges and culverts, and top-dressing and harrowing, until at the present time beyond planting shelter, there is very little further development work to be done.

This area is somewhat exposed to the cold winds. Already quite a quantity of pampas-grass has been planted and has made splendid growth. Rows of pampas along subdivision fences would not be costly: young seedlings can be obtained close at hand and a very inexpensive protection fence could be provided by using 3 in. barbed wire. Two or three of these wires strained tightly with one post to the chain and a few stakes between make an absolutely effective cattle fence, even holding back yearlings.

Flax also quickly makes excellent shelter on this class of land.

The land is now carrying good pastures, in which perennial rye-grass, strawberry clover, and white clover are dominant, with red clover, crested dogstail, paspalum, and cocksfoot sub-dominant. Throughout the summer months these pastures "threw" an enormous amount of feed, and the settlers have saved ample quantities of hay for the winter: one settler actually sold hay. It has also been found possible to close up fields this winter for early-calving cows. The stock are all looking well, and the fact that they are being carried at the rate of nearly a

FIG. 1. MIXED PASTURE, PERENNIAL RYE-GRASS, WHITE CLOVER, AND STRAWBERRY CLOVER, FOUR YEARS OLD.

FIG. 2. STRAWBERRY CLOVER COVERING BARE GROUND.

This clover has spread rapidly from the grassed areas to undeveloped portions of reclaimed tidal flats.

beast to the acre of actual pasture speaks well for the land and the management. Last season the butterfat-production varied from 140 lb. to 180 lb. per acre, and there is no reason to doubt that in a short time this will be increased to 200 lb. and over an acre.

The growth of clover has been phenomenal, more especially on the mud-clay soils, where red clover and white clover have been particularly strong, and trouble with bloat has been experienced. The most satisfactory fertilizer has been superphosphate or superphosphate and lime, and to reduce the bloat a settler has been adding small quantities of sulphate of ammonia with the idea of depressing the clover. A better remedy possibly would be the more frequent use of the mower, closing up either for hay or silage, or to mow the clover and allow it to wilt before feeding to cows.

A very satisfactory feature of the establishment of pastures is the growth of strawberry clover, more especially on the sandy and silty soils: these soils are liable to dry up badly in the summer heat, and the strawberry clover, having a deep rooting system, makes strong growth all through these months when the white clover tends to dry out.

These lands grow excellent crops of mangels and turnips, and with the prolific summer growth of pasture, enabling plenty of hay and silage to be saved, the settlers are more inclined to rely on all-grass farming. On small areas and with limited capital the providing of sufficient horse-power and the necessary implements for cropping is not an easy matter. Considering the fertility of the land, however, probably they would be wise to grow a small area of maize each year for seed purposes—maize, to carry their pigs with some grass over the periods when there is no milk, is very valuable, as it enables some pigs to be kept through the winter ready to start fattening immediately the milk-supplies are available, which is preferable to buying-in pigs for this purpose when all pigs are dear to buy. Maize would also reduce their poultry bill considerably.

There are many more tidal areas which could be reclaimed and settled in a similar manner. It must be remembered, however, that reclamation is not a rapid process: main drains and stop-banks must be erected many years before it is attempted to grow grass, and, to remove the salt quickly, underdraining is essential.

In the Kirikopuni district areas of reed sweet grass, glyceria (*Poa aquatica*), have at some time been established in wet, swampy places and along creek-beds, which dry out somewhat in the summer. During an inspection of these areas the highly palatable nature of the feed produced was very noticeable. The surrounding pasture, which consists of paspalum and white clover, had been neglected by the cattle, become rank, and was of a dark colour. The *Glyceria aquatica* areas were being continually grazed, and their paler green colour could be seen from the surrounding hills, thus outlining the creek-beds winding along the flats.

—*Fields Division.*

STRANGLES.

G. K. L. KNOTT, Veterinarian, Live-stock Division.

IN view of the fact that spring is approaching, and with it the time for shows, sales, &c., it is most probable that outbreaks of strangles will occur in various parts of the country. The congregating together of horses, especially young stock, from diverse localities always facilitates the spread of the disease.

Strangles is an acute contagious disease of horses (and of all solipeds) characterized by a catarrhal inflammation of the mucus membranes of the nasal cavities and throat, and by abscess formation in certain lymph-glands, usually the submaxillaries (situated at the angle of the jaw). An atypical form of the disease also occurs commonly known as "bastard" strangles.

The disease has been well-known and recognized for many generations in most countries where horse-breeding has been engaged in. As far back as the beginning of the last century an investigator named Viborg proved that nasal discharges from affected animals are infectious to healthy animals by inoculation, and towards the end of the century Schütz established the importance of the *Streptococcus equi* organism in an affected animal.

The disease occurs in all parts of the world, excepting perhaps the Argentine. It is of interest, and perhaps significance, that the condition known as "roaring" is also supposed to be unknown in the Argentine. The incidence is usually greater in establishments where breeding is carried on, as in these circumstances there is a larger proportion of young stock.

The majority of cases occur in young animals, the most susceptible age being from two months to five years old. The smaller incidence of it in older horses is due either to an immunity gained from an attack of the disease in youth or to a greater natural resistance acquired with age.

CIRCUMSTANCES OF INFECTION.

There are many circumstances which may predispose towards infection, such as fatigue due to transport or long journeys, poor bodily condition or poor feed, hard work whilst immature, bad weather (the disease is more prevalent in autumn, winter, and spring), overcrowding in stables, bringing young horses bred in the country into cities where the different atmospheric conditions may upset the animal. Many other conditions may be added to these, but, in short, any circumstances conducive to a lowering of vitality render the animal more susceptible.

The organism, previously mentioned, which is the usually accepted cause of the disease is *Streptococcus equi*. Some authorities are of the opinion that there is another factor involved, probably an ultra-visible virus, their reason being that this organism is also found in other conditions not associated with strangles. The *Streptococcus equi*, however, is invariably present in affected animals.

CONTAMINATED FOOD.

The most common method of infection is by ingestion of contaminated food or water. As there is usually a copious nasal discharge,

it is obvious that this contamination is easily brought about. It is also apparent how the congregating together of horses of all ages facilitates its spread—in fact, in some countries the condition is commonly known as "dealers' stables disease," &c. Communal horse-troughs are often a fertile source of infection. Flies or wind may play a part. Stables, grooming-tools, feeding-utensils, nose-bags, &c., may remain infected in spite of so-called disinfection. This latter must be very thorough to be really effective.

The pus from discharging abscesses is also infective, and the disease may be transmitted in the semen during service. Foals may infect the mammary glands of their mothers whilst suckling, giving rise to a form of mastitis, or a mare with an infected udder may transmit it to her foal.

The period of incubation—that is, the time elapsing between infection and the appearance of the first symptoms—is from four to eight days.

The Symptoms.

The symptoms may be divided into two types—(*a*) Regular, which is fortunately the commonest type, and (*b*) irregular.

Firstly, dealing with the regular type: Typical attacks commence with dullness, lack of appetite, and some fever, and the temperature rising to between 103° and 105°. The mucus membranes of the eyes and nose become inflamed, and a watery nasal discharge soon occurs. This becomes profuse, thick, and creamy, and there is often a similar discharge from the eyes.

Two or three days after the appearance of the first symptoms the submaxillary glands become hot and painful and begin to swell. They are at first tense and fairly hard, but after a few days have elapsed a soft, fluctuating point is usually discerned at the peak of the swelling, and rupture of the abscess at this point usually results. Some coughing is usually present, and during the process quite large amounts of phlegm and mucus are blown out.

Sometimes the parotid glands and not the submaxillaries become affected. The swelling in this case will be situated over the side of the throat, often nearly half-way up to the base of the ear. When this occurs the animal is subjected to greater distress and discomfort. The head will be held stiffly with the nose poked out in an effort to relieve the distress, as the swelling will in addition be bulging into the pharynx. Breathing and swallowing will be extremely painful, difficult, and often impossible. The laboured breathing greatly exhausts the patient, and sometimes it is necessary to perform an operation, whereby the windpipe is opened, in order to relieve the distress.

Strain on the Heart.

In these severe cases there is a great strain on the general system and heart, and the mucus membranes assume a bluish tinge. Another danger when the abscess forms in this site is that it will burst inwards and perhaps be inhaled into the lungs, when a very fatal form of pneumonia will be set up. However, great relief results when the abscess is lanced at the correct stage of development or ruptures externally of its own accord, no matter whether

it be in the submaxillary or parotid glands. From this point, providing there are no complications, there is a gradual return, through convalescence, to normal health. It is very essential that the animal should have a good spell even after all symptoms have subsided, as the internal organs, such as the heart, will take a considerable time to recuperate their normal health and strength.

Many different complications may occur during or as a sequel to an attack of strangles—chief amongst them are pneumonia and abscess formation in an internal organ. The tendons or tendon-sheathes may become affected, resulting in chronic contracted tendons. The joints may become the seat of abscess formation, causing lameness and irreparable damage. The udder in lactating mares may develop mammitis, due to the spread of the organism. The air sinuses of the head may become the site of chronic inflammation, giving rise to a persistent nasal "gleet" or discharge. Those "sinuses" are air spaces in the head formed by certain porous bones. Another possible complication is a disease known as *Purpura haemorrhagica*. It is thought that an attack of strangles predisposes to whistling and roaring, stringhalt, and shivering, and to the common osteo-arthritic diseases of the joints and bones.

Irregular Types of Disease.

The symptoms in the irregular type may be very diverse, depending on the organs involved. There is invariably present the inflammation of the nasal mucus membrane, but the submaxillary and parotid glands may remain normal or other glands become the seat of trouble, or the mesenteric glands, situated in the belly, giving rise to colic and fatal peritonitis when they rupture. An abcess in the chest may affect the lungs or heart.

The progress in the irregular type is usually less favourable. In the regular type it is quite hopeful, providing the animal is given reasonable treatment and good nursing. The most essential part of treatment is good nursing and hygienic surroundings.

The affected cases should be isolated, and care should be taken that the disease is not spread to healthy animals by grooming or feeding utensils, or by the attendant himself.

The patient should be well rugged up if the weather is not hot, but should be given plenty of fresh air. Lack of fresh air greatly increases the risk of complications. Clean drinking-water should be available, and should be changed often as it soon becomes fouled by the nasal discharge. From 2 oz. to 3 oz. of Epsom salts may be given daily in the drinking-water. The animal is better not tied up, and should be allowed free use of his head. The nose and eyes should be kept clean by sponging out frequently. This prevents the discharge from "scalding" the skin. The swelling in the glands may be treated with fomentations, liniments, or a mild blister, in order to hasten the ripening of the abscess. When ripe—that is, when a definite soft doughy spot, which tends to shed its hair, can be felt—it should be lanced with a knife previously sterilized by boiling. There is a considerable danger of damaging a nerve or blood-vessel if this operation is performed too soon. After opening, the cavity should be syringed out daily with a disinfectant and the skin surrounding the wound kept clean. The cavity should heal from the bottom, and the lips of the wound should be kept open whilst this proceeds by inserting a clean plug of cotton-wool.

Avoid drenching the animal, as much damage may be done by it, and, in any case, very little good would result.

If the breathing becomes very thick relief may be obtained by inhalations of steam from hot water, to which has been added a few drops of turpentine, oil of eucalyptus, or Friars balsam.

Importance of Feeding.

The feeding of the patient is of importance. The bowels may be regulated with bran mashes. If the animal can swallow easily green foods may be given, or a little steamed hay, crushed oats, or, occasionally, sliced carrots. In any case, the food should be of a soft non-irritating nature.

If swallowing is difficult sloppy foods should be given—for instance, thin oatmeal or linseed gruel, hay tea, or milk and raw eggs. These things are best given in a bucket on the ground or placed in some low position as the chance of it "going down the wrong way"—down the windpipe—is not as great when given thus. Any food not eaten by the animal should be removed and not left in front of him to become fouled.

In good warm weather the animal may be better out in the open providing some shade is available and that flies and dust can be avoided as far as possible.

Subsequent to recovery a long rest is essential, and when work is resumed it must be done so gradually, otherwise serious and irreparable damage may be done to the heart or wind.

In severe and complicated cases professional advice should be sought, as special lines of treatment may be indicated to meet the individual requirements of the case.

Regarding prevention, predisposing causes already mentioned should be avoided as far as possible. When an outbreak occurs, strictly isolate the affected cases. At one time strangles was regarded as an inevitable complication in the rearing of young horses, and it was the practice to try to spread it to all the susceptible horses in the stable when an outbreak occurred. The object was to get the trouble over as soon as possible, as one attack renders the animal immune to subsequent infection. The practice is of doubtful value, and not to be recommended, as, apart from other factors, some authorities are of the opinion that at least 15 per cent. of recovered animals are affected in the wind.

Serums and Vaccines.

There are certain serums and vaccines which are reputed to be capable of conferring, at any rate, a temporary immunity to the disease. These may be useful in protecting horses which are liable to be exposed to infection when coming into contact with horses from other establishments or districts, and they may also be of value as a curative agent in treatment; but, so far, it can definitely be taken that there is no recognized specific inoculation, either as a preventative or curative, for this disease, and until the discovery of the causative agent is finally determined inoculations will of necessity be of a "hit or miss" nature.

Owners would be well advised to direct their efforts towards nursing, management, &c., rather than to the use of nostrums of questionable value.

CONTROL OF BROWN-HEART IN SWEDES.

J. W. Woodcock, Crop Experimentalist, and D. M. Merry, Assistant Crop Experimentalist.

Following on results of field trials conducted in the 1935–36 season* further experiments have been carried out by the Fields Division during the past season to ascertain—

(*a*) The minimum quantity of borax necessary to control brown-heart :

(*b*) The effect of borax on seed-germination at various rates of application :

(*c*) The effect of the addition of lime to borated fertilizer mixtures on germination and control of brown-heart :

(*d*) The effect of applying borax broadcast before and after sowing.

The thirty-five trials laid down on swede crops were distributed throughout districts where brown-heart has been prevalent in the past.

Methods used in Trials.

The Beaven half-drill strip method was adopted where comparisons of the various treatments with and without borax were included. This method, in which the manure-box is divided, allows one-half of the fertilizer to be sown with borax and the other half without. Contrary to expectations the admixture of even small quantities of borax with fertilizer affected the rate at which the fertilizer was delivered, thus making the application of a stipulated quantity exceedingly difficult. The fertilizers used were of various types, including proprietary manures, farmers' own mixtures, and fertilizer plus lime mixtures. The method of sowing included 7 in. drills, 14 in. drills, and the 26 in. ridges usual in Southland. In several trials in which the ridger was used part of the fertilizer and borax was sown from the front box of the drill and part from the rear box, thus securing placement of part of the mixture below the seed.

Application of Borax.

Borax was mixed and drilled along with the fertilizer and seed in the majority of trials, and in these the amounts of borax applied were 3 lb., 6 lb., 9 lb., and 12 lb. per acre. In the remainder the material was broadcast at 8 lb. or 10 lb. per acre either prior to or immediately following drilling, while in a few of these broadcast applications were made at thinning, and also when the crop was half grown, in addition to the dressings given at seeding.

Effects on Germination or "Strike."

Observations were made shortly after the sowing of the trials to determine the extent of any detrimental effect on seedling development. Previous experience* had indicated that under certain conditions borax sown along with the fertilizer and seed could exert a certain amount of injury. The appearance of creamy-coloured cotyledons and a retardation of growth at the cotyledon stage are the general symptoms of this toxic effect. Under some circumstances, probably regulated by

* Woodcock, J. W.: *N.Z. Journal of Agriculture*, Vol. 53, No. 2; August, 1936.

soil-moisture conditions, these symptoms may disappear at a later stage, but under conditions more unfavourable to growth many of the seedlings perish and cause a patchy "strike." Where the latter conditions were easily apparent in the experiments this fact was noted, although sometimes actual plant counts were taken.

No germination injury or retardation of growth was apparent in any of the trials in which borax was *broadcast*, although in one, where it was applied at the thinning stage, further development was retarded.

When *drilled* along with fertilizer and seed, borax sometimes caused a reduction in the field germination. With the heavier rates of application—9 lb. and 12 lb. per acre—poor strikes were frequent and seedling development was retarded, this applying to fertilizer mixtures with and without the addition of lime.

The following table summarizes the general effect of borax in the trials in which the material was drilled with fertilizer and seed :—

Table 1.—Effect of Borax sown with Fertilizer on "Strike" of Swedes.

Effect on Strike of Different Quantities of Borax.	Number of Trials.
No detrimental effect from borax treatment	10*
3 lb., 6 lb., and 9 lb. had no effect ; 12 lb. was detrimental	1
3 lb. and 6 lb. borax had no effect ; 9 lb. and 12 lb. detrimental ..	2
3 lb. had no effect ; 6 lb., 9 lb., and 12 lb. detrimental	2
3 lb., 6 lb., 9 lb., and 12 lb. borax all detrimental	13†

* Includes six trials in which 8 lb. or 10 lb. borax were the only quantities used. † Includes two trials in which 9 lb. or 10 lb. borax were the only quantities used.

In several experiments not included in the above table germination on both treated and untreated areas was poor, and it was not possible on these to carry out counts or estimates with any degree of accuracy. Although various methods of drilling have not been investigated in any one trial a general review of the experiments indicates that more severe injury took place in the crops drilled 14 in. apart than those spaced in 7 in. rows or 26 in. rows (where part of the borated fertilizer had been sown below the seed).

Effect of Borax on Control of Brown-heart.

Inspections of the crops were made just prior to feeding off and a number of roots (generally 50 or 100) on each treatment were taken at random and cut for examination. In seven trials no brown-heart was detected in any of the treatments.

Where borax was applied *broadcast* before sowing at 10 lb. per acre, control of brown-heart was satisfactory in five trials, while in two experiments the disease (slight in both cases) was not controlled by the treatment.

Table 2 summarizes the position in respect of brown-heart control where borax in various quantities was *drilled* with seed and fertilizer.

Table 2.—Summary of Results from Borax sown with Fertilizer on Incidence of Brown-heart in Swedes.

Degree of Control from Borax.	Number of Trials.
Trials free from brown-heart	4
Complete control or high degree of control from 3 lb., 6 lb., 9 lb., and 12 lb.	7
Complete control or high degree of control from 6 lb., 9 lb., and 12 lb. only	3
Complete control or high degree of control from 8 lb., 9 lb., and 12 lb. only	4*
Complete control or high degree of control from 12 lb. only ..	3
Moderate control from 3 lb., 6 lb., 9 lb., and 12 lb. borax	3
Brown-heart (all slight infection) not controlled by borax	3†

* Includes three trials in which 8 lb. borax was the only quantity used. † Includes two trials in which 8 lb. borax was the only quantity used.

Comments on Table 2.

Out of twenty-three trials in which brown-heart was present, borax gave a complete control or a high degree of control (reduced the infection by 70 per cent. or more) in seventeen. In the three trials where borax had no effect and in one trial where control of brown-heart was only moderate, the infection was only slight, the number of infected bulbs being less than 5 per cent. on the untreated plots in each case. This leaves two experiments in which fairly severe infection was only slightly reduced by borax.

Owing to early retardation of growth as a result of applying borax with manure and seed the swedes on treated areas were often small although free from brown-heart. However, in some trials it was noted that the "intensity" of brown-heart infection on individual roots was more severe on treated than on untreated drills. In one trial the infection was more severe on the drier knolls, while in another one located on two distinct soil types the incidence of brown-heart was several times greater on a peaty soil than on a friable loam; the addition of borax was effective on both soil types however.

Summary and Recommendations.

From the results of thirty-five trials carried out to investigate the effect of borax applied by different methods on control of brown-heart, it would appear that the method of mixing borax with fertilizer and sowing in intimate contact with swede-seed is open to some risk owing to a possible adverse effect on the "strike." This occurred in some instances with quantities of borax as low as 3 lb. per acre. The application of borax at 10 lb. per acre broadcast before sowing had no such adverse effect.

Satisfactory control of brown-heart was obtained from borax applications except in six experiments, in two of which neither drilling nor broadcasting had any effect. The incidence of brown-heart in four of these unsatisfactory trials was only slight. Of the trials in which borax was drilled, the application of 3 lb. or more per acre gave a high degree of control in seven, in three the minimum

effective quantity was 6 lb., while in seven at least 9 lb. to 12 lb. appeared necessary. In one of the latter, whereas applications at 3 lb. and 6 lb. respectively were only slightly effective, 10 lb. of borax broadcast prior to sowing appeared as satisfactory as 9 lb. and 12 lb. applied in close proximity to the seed. Broadcasting the material at about the thinning-stage appeared to be equally efficient as broadcasting prior to seeding, although the latter should be preferable. When applied to crops about half-way through the growing-period, borax was generally less effective. The addition of lime to borated mixtures showed no advantage or detriment either as regards effect on "strike" or control of brown-heart.

In view of the possibility of injury to the establishment when borax is applied with the seed, wherever possible the material should be applied at from 10 lb. to 20 lb. per acre *broadcast* before sowing or shortly afterwards. To facilitate distribution it should be applied either along with sawdust or soil. If top-dressing is impracticable the drilling of 3 lb. to 6 lb. of borax per acre is less likely to cause severe injury than with the heavier applications, and from the evidence obtained this quantity is likely to have a fair measure of control. By sowing the crop in 7 in. drills, or by putting half the borated fertilizer below and half with the seed, as is possible with the ridger, the liability to injury is likely to be further reduced.

ACKNOWLEDGMENTS.

The field work in connection with the trials was carried out by Instructors of the Fields Division under the direction of Fields Superintendents at Hamilton, Palmerston North, Christchurch, and Dunedin respectively. Thanks are extended to the farmers who co-operated in carrying out the experiments.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published recently in the *New Zealand Patent Office Journal*, include the following of agricultural interest:—

No. 78127: Mower-driving means; C. E. Bailey. No. 78144: Turnip-cutting tool; W. de M. Lindop. No. 78150: Manure-distributor; G. R. Petch. No. 78152: Teat-cup; S. A. C. Gallichan and A. C. Kerr. No. 78156: Plant-growing method; W. Malone. No. 78169: Sheep overall; Smith, Copeland, and Co., Pty. No. 78192: Shearing-machine comb-trimmer; J. B. Anderson. No. 78218: Grassland cultivator; H. T. Gillies. No. 78229: Cultivator; A. V. Pettman. No. 78248: Teat-cup; C. F. Laxton. No. 78270: Water-pump; G. S. Foote. No. 78278: Milk-delivering means; H. W. Lee. No. 78289: Fencing-post; A. Howard. No. 78292: Fencing-dropper; W. Stubbs.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price 1s. prepaid.

Silver poplar (*Populus nivea*) has been declared a noxious weed within the Borough of Matamata.

Phalaris arundinacea has obtained a good footing in a swamp at Kopuka, and rivals *Poa aquatica* in its aggressiveness in the swamp, yet providing more palatable and earlier feed. It is ousting blackberry and rushes. It appears to be more aggressive than *Poa aquatica* on the less wet parts of the swamp and it is expected that it will prove a valuable addition to the swamp grasses in the lower Waikato Basin.—*Fields Division.*

WINTER GRASS.

E. R. MARRYATT, Ruakura Farm of Instruction, Hamilton.

WITHOUT nitrogen grass will not grow. When the soil is warm, growing clover supplies nitrogen to grass, and at that stage artificial nitrogen is not economical. In the winter, however, when the soil is cold, and normally clover is growing very feebly, artificial nitrogen may be profitable when correctly used.

ARTIFICIAL NITROGEN, PLUS SUPER, FOR WINTER GRASS.

The correct use of artificial nitrogenous fertilizers, particularly sulphate of ammonia, demands prior and adequate phosphating and liming of the pasture; at least 3 cwt. of each to the acre every year is necessary. Artificial nitrogenous fertilizers may be applied between April and August, but for winter grass they should be applied in April or early May, and, particularly, only when the grass is still growing and when it has some little growth—say, 2 in. Keeping stock off the treated pasture until the growth has reached about 9 in. is equally as important. The top of the spelled pasture should then be grazed off, leaving about 3 in. ungrazed. Do not graze bare. Then spell the pasture again.

USE OF SUPERPHOSPHATE ALONE.

When sufficient clover in a pasture has been growing vigorously for a month or two prior to the winter, it will continue to supply some nitrogen to the grass even when the soil becomes fairly cold. If the clover has been refreshed by a March or April top-dressing of super and thereafter spelled from grazing, it will provide the most nitrogen possible. It will continue to supply some nitrogen to the grass even when the soil becomes very cold.

In order to allow a growth of grass for the winter, hay and other supplements must be fed out before they are actually required. Feeding out normally begins when pastures have been grazed bare; but to grow winter grass feeding out must begin some weeks before it is actually necessary. Only in this way can fields be closed up while the grass is still growing.

BOTH METHODS AT RUAKURA.

This year both methods of providing winter grass have been tried at Ruakura.

Transport difficulties unfortunately delayed the application of nitrogen. The sulphate of ammonia was not applied until the 7th June. By this time the pastures had been spelled since the 19th April—forty-nine days of mild "growthy" weather. The growth averaged 6 in. Still more unfortunately, hard frosts followed. Frosts of 6·4 degrees, 16·7 degrees, and 7·4 degrees were recorded on the first three nights. Little improvement due to the nitrogen can therefore be expected until after the first grazing-off; no differences have yet been seen. On the 14th July the growth averaged 8 in.

On the other hand, the superphosphate treatment ran to schedule, and the weather was favourable. The superphosphate fields were also closed to stock on the 19th April, being top-dressed with superphosphate and lime on the same day. The growth on the 14th July averaged 8 in.

Both sulphate of ammonia and superphosphate treated pastures are to be grazed immediately. They are to be grazed down as evenly as possible to about 3 in. or 4 in. The aim is to let the light in to the clovers, and also to prevent the undergrowth from decomposing and becoming not only unpalatable, but also quite useless.

FIG. 1. SIDE VIEW OF TURF REPRESENTING THE PASTURE ON 13TH JULY, 1937.
Pasture consists mainly of fog, rye-grass, cocksfoot, and white clover.
[*Photo by H. Drake.*

Free Nitrogen compared with Purchased Nitrogen.

The most obvious and important difference is one of cost. This will be the difference between the total cost of applying the artificial nitrogen and the value of the return of growth over and above that returned by superphosphate alone. Management and the season together will decide whether the cost will be returned. The weather is very important—for example, this autumn and early winter was very mild and favourable to natural nitrogen ; clovers grew well and supplied plenty of nitrogen to the grass. Grazing management is also very important, and the Ruakura grazing trials have been arranged to teach us something about it.

Other differences between artificial and natural nitrogen-grown grass are comparatively unimportant, but they are interesting. All artificial nitrogen is not fool-proof; superphosphate is. On the other hand, artificial nitrogen-grown grass does not "winter-burn" as does natural nitrogen-grown grass. Again, response from superphosphate is spread out over a longer period than is that from applied nitrogen. Against this, however, in natural nitrogen-grown grass shut up for a long time, partial decomposing of the undergrowth may occur; but suitable grazing management is expected to overcome this difficulty.

FIG. 2. TOP VIEW OF TURF IN FIG. 1.

Pasture shut up on 19th April; photo taken on 13th July, after eighty-five days' spelling. Commencing on the 19th July, forty-six P.A. cows and forty-six P.A. calves of mixed ages and sizes grazed the winter-spelled area of $7\frac{1}{8}$ acres for eight full days. There was then from 3 in. to 4 in. of herbage ungrazed.

[*Photo by H. Drake.*

Conclusion.

Without nitrogen grass will not grow. Clovers and live-stock supply enough nitrogen to grass on most New Zealand pastures, except in the winter. Winter grass may be grown either by buying artificial nitrogen and putting it on the pastures, or by giving the clovers every opportunity to carry on their good work. Both methods are good. The season itself will decide whether purchased nitrogen pays.

There is a big interest being taken in subterranean clover in the Marlborough District. Many farmers have placed large orders for the seed. The seed sold so far is of local production, the Australian product not yet having arrived. An idea of the magnitude of some of the orders may be gleaned by one of thirty 200 lb. sacks—sufficient to sow down 1,500 acres. This seed is going on to a back-country run, where it should be very beneficial.—*Fields Division.*

GRADING OF EXPORT BUTTER AND CHEESE.

LEADING DAIRY FACTORY AVERAGES FOR THE YEAR 1936-37.

BUTTER-MANUFACTURING companies which have obtained an average grade of 94 points or over and cheese-manufacturing companies which have obtained an average grade of 93 points or over are listed below. Of the total of 182 creameries and dual-plant factories manufacturing butter for export, thirty-four are included in the list, as compared with thirty-two for the preceding year, and of the 297 cheese-factories and dual-plant factories manufacturing cheese for export, twenty-two, as compared with twenty for the previous year, have averaged 93 points or over. Of the total factories listed, twenty-six butter and thirteen cheese are situated in the North Island and eight butter and nine cheese in the South Island.

Company or Proprietor.	Registered No.	Brand.	Tonnage graded.	Average Grade.
Butter-factories.				
T. and P. Milk-supply Co., Ltd.	54	Sweet Briar, &c. ..	27	94·959
Rangitikei Co-op. ..	1360	Rangitikei	686	94·826
Murchison Co-op. ..	1888	Airship	262	94·778
United Co-op.	1296	Whariri	279	94·752
Kaikoura Co-op. ..	302	Kai	220	94·751
Rodney Co-op... ..	394	Rodney	438	94·684
Collingwood Co-op. ..	1254	Golden Hills ..	226	94·654
Awahuri Co-op. ..	664	Red Rose	850	94·635
Rangiwahia Co-op. ..	750	Quail	150	94·629
Taihape Co-op. ..	1188	Tikapu	535	94·542
Eketahuna Co-op. ..	46	Eketahuna ..	181	94·474
Rata Co-op.	938	Rata	1121	94·430
Northern Wairoa Co-op.	4	Northern Wairoa ..	624	94·390
Levin Co-op.	910	Lake	1573	94·367
Karamea Co-op. ..	302	Karamea	224	94·340
Ruawai Co-op. ..	66	Ruawai	1681	94·308
Golden Bay Co-op. ..	146	Sovereign	721	94·280
Cheltenham Co-op. ..	3	Pakeha	2172	94·253
Shannon Co-op. ..	1489	Shannon	1232	94·241
Maungaturoto Co-op. ..	1407	Otamatea ..	1153	94·230
Uruti Co-op.	300	Uruti	257	94·219
Rongotea Co-op. ..	8	Rongotea	1012	94·209
Lepperton Co-op. ..	49	Lepperton	176	94·177
Wangaehu Co-op. ..	1326	Wangaehu ..	640	94·150
Inter-Wanganui Co-op. ..	6	Inter-Wanganui ..	187	94·149
Municipal Milk Department, Wellington	202	Rahui	128	94·131
Piopio Co-op.	603	Piopio	475	94·111
Tolaga Bay Co-op. ..	1007	Tolaga Bay ..	281	94·055
Masterton Co-op. ..	1307	Masterton ..	888	94·037
Kuku-Manakau Co-op. ..	905	Ohau	236	94·028
Arahura Co-op. ..	1516	Arahura	79	94·027
Takaki Co-op.	1463	Bell	562	94·023
Kaikohe Co-op. ..	40	Kaikohe	308	94·013
Kaipara Co-op. ..	794	Popular, Filbert ..	2506	94·012

Company or Proprietor.	Registered No.	Brand.	Tonnage graded.	Average Grade.
Cheese-factories.				
Kaimata Co-op. ..	992	The Oaks	391	93·732
Rai Valley Co-op. ..	519	Rai Valley ..	314	93·691
Milton Co-op.	1030	Milton	105	93·601
Omimi Co-op.	74	Omimi	59	93·547
Little Akaloa Co-op. ..	32	Little Akaloa ..	55	93·468
Stirling Co-op. ..	292	Stirling	329	93·307
Westmere Co-op. ..	1621	Westmere ..	356	93·276
Cardiff Co-op.	10	Cardiff	662	93·269
Stratford Co-op. ..	219	Huinga	303	93·210
Wairewa Co-op. ..	471	Wairewa	144	93·203
Mangawhata Co-op. ..	1343	Mangawhata ..	362	93·202
Parkvale Co-op. ..	1240	Parkvale	306	93·180
Royal Oak Co-op. ..	693	Royal Oak ..	137	93·163
Titiroa Co-op.	361	Cloverpark ..	130	93·159
Kahui Co-op.	493	Kahui	280	93·115
Waikaka Co-op. ..	1067	Waikaka	27	93·104
Kaponga Co-op. ..	1696	Rowan	381	93·084
Dannevirke Co-op. ..	391	Dannevirke ..	188	93·070
Cam Co-op.	168	Cam	95	93·067
Rapanui Co-op. ..	1714	Southern Grove ..	121	93·065
Pembroke Co-op. ..	234	Pembroke ..	383	93·046
Jolls, T. L., Co-op. ..	1862	Maori Chief ..	468	93·042

—*Dairy Division.*

NOTES ON RECENTLY OBSERVED EXOTIC WEEDS.

H. H. Allan, Plant Research Station, Palmerston North.

10. Mexican Marigold (*Tagetes minutus*).

This potentially serious weed has recently been observed by Mr. M. Hodgkins in waste places about Auckland, and has also been noted near Palmerston North. It belongs to a genus of composites containing about twenty species indigenous to the sub-tropical and tropical parts of the Americas, several of which have become naturalized in other parts of the world, though none appears to have become of moment in the United States. From the wild plants have also been developed certain favourite garden plants curiously misnamed "French" and "African" marigolds.

T. minutus has given trouble both in South Africa and in Australia, in the latter country being known as "stinking Roger." Bailey ("Weeds and Suspected Poisonous Plants of Queensland," 1906) says it "has become one of the worst of our cultivation weeds." In Europe it has established itself in various parts of Germany and in Switzerland, its entry into the latter country being traced to refuse from Australian wool. Lansdell ("Weeds of South Africa," 1925) says, "This weed was probably introduced into South Africa during the Anglo-Boer War, and was first reported from the Charlestown district, Natal. It is now widely distributed in the Union and Rhodesia." She speaks of the rapidity of its spread as "almost incredible," and remarks that it has

"a wonderful adaptation to various climatic conditions, and it passes through several life cycles in one season." It is now proclaimed as a noxious weed in most parts of the Union. Lansdell's recommendations

FIG. 1. MEXICAN MARIGOLD (*Tagetes minutus*).

(After K. A. Lansdell in "Weeds of South Africa." Government Printer, Pretoria.)

for control are—"All plants should be pulled up and burnt. In cultivated grounds tillage should be continued late in the season in order to prevent the development of seed from late-blooming flowers." This would appear a tremendous piece of work for South Africa, but

is a practicable proposition for New Zealand if attended to at once. Certainly the specimens I have seen testify to the plant's powers of luxuriant growth and heavy production of seed, at least in the warmer parts of the country, and it is obvious that neglect for a very few seasons would enable it to become thoroughly established.

T. minutus (Mexican Marigold), (Fig. 1): An erect, much-branched annual, reaching anything from 3 ft. to 9 ft. high, with smooth, tough stems. The leaves are rather "fern-like" with about three pairs of leaflets and a terminal one. The leaflets are about 2 in. to 3 in. long, narrow, lance-shaped, and strongly toothed. The flower-heads are narrow tubes, about $\frac{1}{2}$ in. long, produced in great masses at the tips of the branches. There are six to twelve flowers to the head, the outer with small yellowish rays, the inner tubular. The fruits are narrow, about $\frac{1}{4}$ in. long, tapering to the base, black, but covered with appressed brownish hairs, and furnished at the tips with six whitish chaffy scales, of which one is much longer than the rest. The whole plant when bruised has a distinct "marigold" odour.

11. Yellow Weed (*Galinsoga parviflora*).

The few species of the genus of composites to which this belongs range from Mexico to the Argentine, the present species having its headquarters in Peru. It is now very widely spread, being found throughout the Americas, over the greater part of Europe, in Africa and eastern Asia, and in Australia. The European occurrences are considered to be derived from its early cultivation in the Paris Botanical Garden, where is was introduced in 1794 and whence it was distributed to other botanical institutions. Hegi, in his Illustrated Flora of Europe, gives a detailed account of its escapes from cultivation and its widespread establishment. In England the plant is particularly common about Kew, being first grown at the Kew Gardens in 1796. It appeared in Australia as early as 1873, and is now widely spread, though apparently not especially common in any locality.

In all countries it appears to favour good soil, and is mainly a garden or waste-place weed controllable by the usual treatment for annuals. Seed-production is considerable, and if seeds become buried at all deeply they remain dormant and viable for a number of years. The plants are rather frost-tender, but in very warm areas may be bearing flowers six weeks after germination.

The plant was first noted in New Zealand by Kirk in 1892 on a heap of ballast deposited by a ship from Buenos Ayres. It appears to have died out, as no further record of it has been made about Wellington. In 1935 I noted a number of plants on reclaimed land at Stanley Bay, near Auckland, and subsequently several gardens were found to contain it. As a weed it will have much the same place as the groundsel, where frost is not severe.

Galinsoga parviflora (Yellow Weed), (Fig. 2): An erect annual, varying greatly in stature according to soil conditions, when well developed of a bushy habit, 18 in. high or more. The stems are six-angled in the lower parts, usually with a three-fid arrangement of the branchlets. The leaves are in pairs, thin, ovate, and tapering to the tips, more or less bluntly toothed on the margins, about $1\frac{1}{2}$ in.

to 2 in. long. The flower-heads are small, about $\frac{1}{4}$ in. across, and usually occurring in groups of about three on slender stalks. The outer floret has small white rays and the inner are tubular and yellow.

FIG. 2. YELLOW WEED (*Galinsoga parviflora*).

The fruits are small, four-sided, dark-brown, with a covering of white hairs, and surmounted by thin, flat scales with comb-like fine teeth on the margins.

TOBACCO-MOSAIC.

ITS APPEARANCE, CAUSE, AND CONTROL.

E. E. CHAMBERLAIN, Plant Diseases Division, Plant Research Bureau, Department of Scientific and Industrial Research.

AT some stage in the history of most of the main tobacco-growing regions of the world tobacco-mosaic has become a serious problem to the grower. That the disease is now of minor importance in many of these regions shows that it may be controlled when adequate precautions are taken.

In New Zealand it is only within the last four or five years that tobacco-mosaic has become a major problem. As yet, there has been no organized attempt to control it. Provided strict precautions are taken, however, there is no reason why the disease should not be as effectually controlled here as in other countries. In this paper, based on experimental results published elsewhere (Chamberlain, 1937*), are indicated measures necessary for its prevention.

APPEARANCE ON THE PLANT.

The most obvious symptom of tobacco-mosaic is a mosaic pattern of light- and dark-green areas on the leaves (Fig. 1). The design of this pattern is not constant (Figs. 1 and 3), but the dark-green areas usually occur along the veins (Fig. 1). A blistered appearance of the leaves sometimes results from more rapid growth of the darker green tissue (Figs. 2 and 4). Leaf-spotting also frequently develops on infected plants (Fig. 5), this type of injury being most prevalent on Burley varieties (Fig. 6).

Plants which become infected early in the season are usually much stunted (Figs. 7 and 8), while those infected later are not so much reduced in size. In the case of a severe attack, resulting from an early infection, the leaves are narrow, puckered, thin in texture, and often spotted, and are valueless for curing purposes (Figs. 2 and 6).

When tobacco-mosaic attacks a plant late in the season symptoms show only on the new growth. Thus if a plant becomes infected during topping, mottling usually develops only in the laterals.

On seedling plants the symptoms are not so conspicuous, consisting of a few dark-green raised areas on two or three leaves (Fig. 4). Such plants are usually smaller than healthy seedlings, and, in the seedling-beds, are often hidden by the leaves of adjacent healthy plants.

Symptoms do not develop immediately after Infection.—The mosaic mottling of the leaves does not appear until about two to four weeks after infection has taken place. The time taken for symptoms to show depends upon the rate of growth of the plants, being less than two weeks if they are growing vigorously and greater than four weeks if they are growing slowly.

* Chamberlain, E. E. (1937): *N.Z. Jour. of Sci. and Tech.*, Vol. XIX, No. 4, September, 1937.

Cause of Tobacco-mosaic.

Tobacco-mosaic is caused by one of a well-defined group of diseases known as plant viruses. The word "virus" is used to describe a large group of diseases some of which attack man, some animals, and other plants. A well-known virus disease of man is "infantile paralysis," and one of the best-known plant viruses is "tobacco-mosaic."

FIG. 1. MOSAIC MOTTLING OF TOBACCO-LEAF CAUSED BY TOBACCO-MOSAIC.

FIG. 2. MOSAIC-INFECTED TOBACCO-LEAF.
Showing narrowing and blister type of mosaic mottling.

[*Photos by H. Drake.*

These two diseases show general similarities: both are spread by contact and are caused by minute organisms. They are dissimilar in that a person may recover from an attack of infantile paralysis, but a tobacco-plant never recovers from an attack of tobacco-mosaic.

Plant viruses are usually spread by insects or by rubbing the juice from a diseased plant over the leaves or stem of a healthy plant. The tobacco-mosaic present in New Zealand is the same as that which occurs in other countries.

Extent to which Tobacco-mosaic occurs in New Zealand.—It is only five years ago that tobacco-mosaic first began to be a serious problem to growers in the Nelson District. Since then it has increased to such an extent that, to-day, it is the most important factor in the economic production of tobacco-leaf.

An inspection of crops throughout the district has shown that the amount of tobacco-mosaic has steadily increased during the past four seasons. The estimated average percentage infection in 1933 was less

FIG. 3. TOBACCO-MOSAIC ON TOBACCO-LEAF.
Showing symptoms in which the mosaic pattern does not follow the veins.
Photo by H. Drake.

than 10 per cent. while during the past season it appeared to be well over 25 per cent. The disease also occurs in the Auckland Province, but to a much lesser extent.

Effect on Yield and Quality of Leaf.—In other countries tobacco-mosaic causes a reduction in crop-yield, and the leaf from plants infected early in the season is often valueless on account of its small size, thinness, poor colour, and spotting. Late infection up to the topping stage causes a slight reduction in yield and a lowering in leaf-quality.

The same is true of tobacco-mosaic in New Zealand, leaf-spotting being in particular a destructive feature of the disease in this country. In one crop of Burley tobacco, examined in 1933, leaf-spotting following mosaic was so severe that over 20 per cent. of the crop was left unharvested.

Trials in experimental plots at Palmerston North have shown that infection of plants shortly after they have been set out in the field caused a reduction in yield of 44 per cent. in a Virginian variety and 78 per cent. in a Burley variety. Leaf from these plants was quite useless for curing purposes (Fig. 6). Infection later in the season caused a reduction of 24 per cent. in the Virginian and 25 per cent. in the Burley variety. The leaf was of poor quality, but some of it was of a saleable grade (Fig. 6).

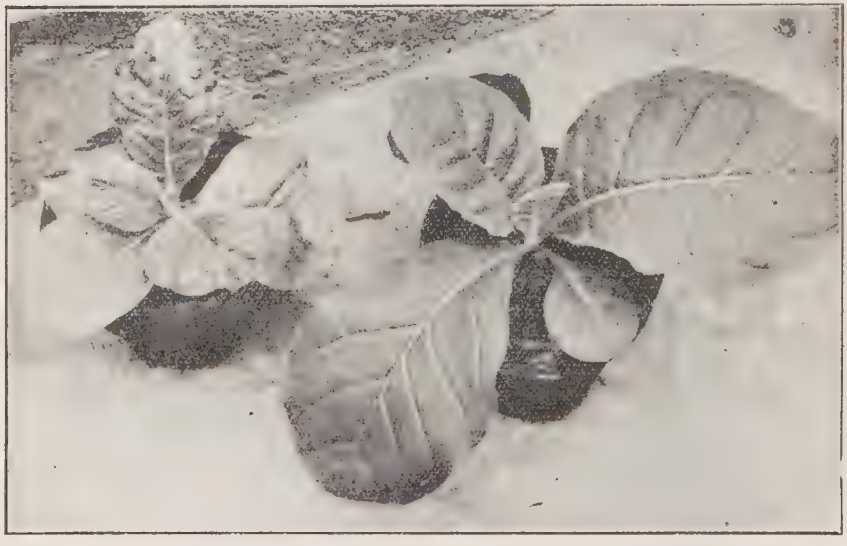


FIG. 4. TOBACCO-MOSAIC ON SEEDLING TOBACCO-PLANT.
Showing blister-like dark-green areas. Healthy plant on right.
[*Photo by H. Drake.*

Tobacco-mosaic also occurs on other Plants.

Many plants are attacked by tobacco-mosaic, the most important of these under New Zealand conditions being tomato, black nightshade, Cape gooseberry, Turkestan tobacco, egg-plant, and chilli. Of these, tomato and black nightshade* are the only ones likely to play a part in the spread of mosaic to tobacco crops. The symptoms on these plants are similar: a light- and dark-green mosaic pattern on the leaves and a slight stunting of the plant. Leaf markings are less distinct than they are on tobacco and are sometimes difficult to distinguish. On tomatoes the leaves are sometimes narrowed and distorted.

* Black nightshade is a common weed of gardens and cultivated land. It is often erroneously called "deadly nightshade."

Increase of the Virus in Diseased Plants.

Although only a very small quantity of the virus is necessary to bring about infection of a healthy plant, it increases rapidly after infection has taken place. Thus a well-grown healthy plant may become infected if touched with a finger on which a small quantity of the mosaic virus is present. Three weeks later this plant would yield sufficient virus to infect every tobacco-plant grown in New Zealand.

It has been pointed out that the symptoms of mosaic show only in new growth, and that a plant infected late in the season may show mottling only in the laterals. In such plants the concentration of the virus is as high in the older unmottled leaves as in young leaves showing mosaic symptoms. Thus a plant which has shown symptoms in the laterals only, will, after lateraling, appear healthy and yet be a source from which the disease may be readily spread.

FIG. 5. LEAF-SPOTTING CAUSED BY TOBACCO-MOSAIC ON A LEAF FROM A PLANT OF THE "BURLEY" TYPE.

[Photo by H. Drake.

In America it has been found that the virus is still active in the sap from diseased plants after five years, and that it may persist in the dried leaf for over thirty years. The evidence available shows that the disease may persist for several years under New Zealand conditions.

Occurrence in Smoking Tobacco.

Tobacco-mosaic is not destroyed by the normal curing and manufacturing processes, and may be present, therefore, in prepared tobaccos. Overseas it has been shown that the disease is carried in many brands, and in some places smoking and chewing tobaccos are considered to be mainly responsible for the introduction of mosaic into the crops.

Experiments carried out at Palmerston North have shown that of nine samples of home-cured tobacco and sixteen samples, including nine brands, of manufactured tobacco, all carried mosaic infection. Home-cured tobacco carries the disease more readily than manufactured

tobaccos. In some localities in America control of mosaic has been secured, in conjunction with other necessary precautions, by issuing to workmen tobacco which has been treated by heat to destroy the virus.

Heat Treatment.

It has been found both in New Zealand and in other countries that, when heated for ten minutes, 195° F. is the lowest temperature at which the mosaic virus can be killed. Therefore, in order to destroy the disease it is necessary to maintain tobacco at a temperature in excess of this for ten minutes.

Heat does not penetrate readily into tobacco, and experiments have shown that a sufficiently high temperature cannot be secured by heating it in a tin either above or partly submerged in boiling water. A satisfactory way of destroying mosaic is to heat the tobacco in steam

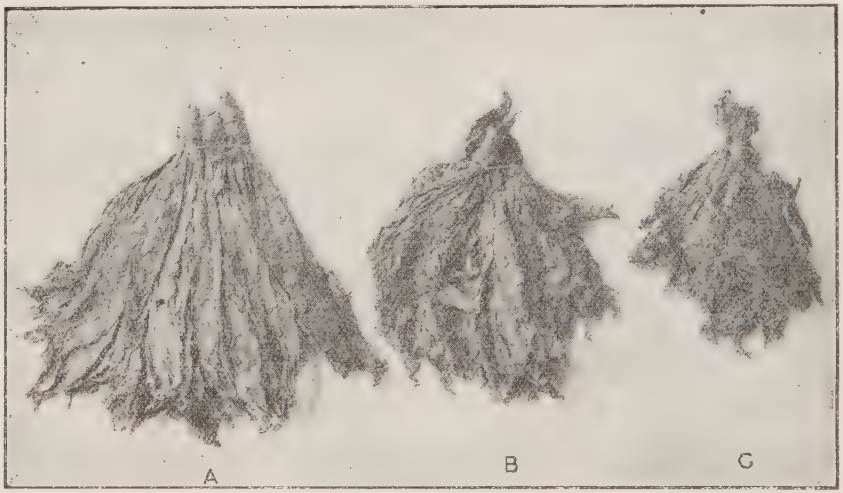


FIG. 6. EFFECT OF TOBACCO-MOSAIC ON THE YIELD AND QUALITY OF LEAF.

Each bundle is the product of six plants. A " Burley " variety.

A. Leaf from healthy plants.
B. Leaf from plants inoculated with tobacco-mosaic on 17th December, 1934.
C. Leaf from plants inoculated with tobacco-mosaic on 5th December, 1934.

[*Photo by H. Drake.*

under pressure. Tobacco in 2 oz. sealed tins may be successfully treated in steam at 10 lb. pressure for fifteen minutes. This method necessitates special equipment, as an autoclave is required to obtain the pressure.

Steam treatment under pressure darkens the colour of the tobacco and alters the flavour slightly.

Infectious Nature of the Disease.

Tobacco-mosaic is the most infectious plant virus disease known. The sap from diseased plants may be diluted to 1 part in 1,000,000 parts water and still bring about infection when rubbed on the leaves of healthy plants.

Infection can take place only through wounds, the disease gaining entrance most readily through very small injuries such as are caused by the breaking of leaf-hairs, which occurs whenever a leaf is touched. Thus, if the mosaic virus is present on the fingers, the mere touching of healthy plants is sufficient to infect them with the disease.

The ease with which infection may be brought about has been clearly shown by experiments carried out at Palmerston North. Sap from

FIG. 7. COMPARISON OF HEALTHY AND MOSAIC-INFECTED PLANTS.
Note stunting of plant and narrowing of leaves.
[*Photo by H. Drake.*

mosaic-infected plants was rubbed on the leaves of over 750 healthy tobacco-plants growing in the field, and all developed the disease.

Spread of Tobacco-mosaic by Handling.

In the field handling of the plants with contaminated fingers is the main method by which the disease is spread. Plants are handled a number of times during the season, affording many opportunities for the introduction and spread of the disease. Observations indicate that most of the infection takes place at the various times of handling—that is, at (1) pricking-out of seedlings into the beds, (2) pulling of plants from the beds and transplanting to the field, (3) topping, and (4) lateraling.

The hands may become contaminated with the virus from (1) infected tobacco-plants already present in the crop, (2) smoking tobacco, (3) other infected plants such as tomatoes or black nightshade, (4) infected leaf or other plant-remains left over from the previous season.

Experiments were carried out to determine the extent to which the disease was spread during lateraling. Two workmen, after lateraling a number of infected plants, each lateraled one row of thirty-five healthy plants. When the crop was inspected three weeks later 83 per cent. of these plants had developed mosaic.

FIG. 8. TOBACCO-PLANTS INFECTED WITH TOBACCO-MOSAIC.

Healthy plants on right. Portion of the 1934–35 yield trials. Variety "Warne."

[*Photo by H. Drake.*

Rapid Spread towards the End of the Season.

The amount of infection in a crop increases rapidly from the topping stage until the end of the season. Thus a crop which is showing 5 per cent. noticeable infection before topping may be 100 per cent. infected by harvest-time. Although the bulk of the leaf from such a crop may be normal in appearance and of good quality, it nevertheless carries mosaic infection.

The virus of tobacco-mosaic may be removed from the hands by thorough washing. It is not easily removed in this way, however, and to be effective the washing must be very thorough. It is advisable to use warm water, plenty of soap, and a nail-brush. Then, to remove all traces of the virus, the hands should be rinsed in running water or a change of water. Care should be taken not to recontaminate the hands from towels carrying infection.

Tobacco-mosaic may remain Alive in the Soil.

The mosaic virus may remain alive in the soil during the winter and bring about infection of healthy plants in the spring. In rare instances it may survive two winters. The disease usually persists in the roots and stalks from infected plants of the previous season, but it may also occur in the soil in the free state. As a rule the amount of infection which takes place from the soil is small although occasionally it may be as high as 25 per cent.

Experiments carried out at Palmerston North have shown that where tobacco-mosaic has been present in a seedling-bed it may remain in the soil and infect the seedlings in the following season. In an instance where seedlings were pricked out into such a bed the plants, although they did not show the disease while in the seedling-bed, showed over 11 per cent. infection after they had been transplanted to the field.

It has also been found that where mosaic-infected plants growing in the field are removed and replaced with healthy plants a high percentage of the replants develop the disease. Thus, of 129 healthy plants replacing diseased ones, 72 per cent. became infected.

Although many virus diseases are spread by insects, the results of investigations here and in other countries indicates that tobacco-mosaic is rarely if ever carried in this way.

In other countries it is generally held that tobacco-mosaic is not carried in the seed of tobacco. An investigator in Russia has claimed, however, that it may be carried in the dust which is often mixed with the seed. Preliminary trials in New Zealand suggest that the disease may sometimes be carried to a small extent either in or with the seed. Further trials are necessary before this question can be considered settled.

It has been shown in experiments at Palmerston North that tobacco-mosaic is carried in a small percentage of seed harvested from infected plants of tomatoes and black nightshade.

Measures for the Control of Tobacco-mosaic.

In outlining measures for its control it is stressed that tobacco-mosaic is very infectious and that it is essential to take the very greatest precautions to prevent its spread. The disease may be introduced in a number of ways, and field observations in the Motueka District indicate that the method of introduction varies from crop to crop. Control measures which are successful in one crop may, therefore, fail in another, so it becomes necessary to carry out all measures with equal thoroughness.

Control of tobacco-mosaic presents two problems: Prevention of introduction of the disease to the crop and prevention of spread after the disease has appeared.

A. Prevention of the Introduction of Tobacco-mosaic to the Crop.

There are three ways by which the disease may be introduced: (1) With the seed; (2) through the soil; and (3) by human agency.

(1) *With the Seed.*—At present no measures are taken to ensure that the seed used on New Zealand is taken from healthy plants. This will become a necessary precaution if it is shown ultimately that tobacco-mosaic is carried with the seed.

(2) *Through the Soil.*—The disease is frequently introduced into the crop through the soil. Plants may become infected by means of contaminated soil in (*a*) seed-boxes, (*b*) seedling-beds, and (*c*) field.

(*a*) Seed-boxes: Soil used in seed-boxes should be steam-disinfected. When steam-disinfected soil is not available fresh soil should be obtained from land which has not been in tobacco or tomatoes for at least two years.

(*b*) Seedling-beds: Beds in which mosaic has appeared should not be used the next season unless the soil is replaced or disinfected with steam. New beds should be prepared on land which has not been in tobacco or tomatoes for at least two years.

If plants in a seedling-bed remain free from mosaic, the bed may be used a second season. All tobacco-plants should be removed as soon as possible after field planting has been completed, and the bed kept free from weeds until it is prepared for the new season.

(*c*) Field: The disease is carried over in the soil mainly in the roots and stems of the previous season's crop. The virus may also be leached out of such plant-remains and persist in the soil in the free state. Therefore all roots and stems should be removed from the field as soon as possible after the completion of harvesting, and, after drying in the sun, should be burnt.

(3) *By Human Agency.*—A great deal of infection with tobacco-mosaic takes place through the handling of plants with contaminated fingers. The many handlings to which the plants are subjected during the growing-season affords excellent opportunities for the introduction of the disease. The fingers of workmen may become contaminated by handling—(*a*) home-cured or manufacture tobaccos; (*b*) rubbish from previous season's crop; (*c*) cured leaf (often discard) left in sheds from previous season; or (*d*) other infected hosts.

(*a*) Home-cured or Manufactured Tobaccos: Since practically all tobacco carries infection, smokers working with plants should smoke only sterilized tobacco.* This precaution should be taken from the commencement of pricking-out of seedlings into the beds until harvesting, and both at work and at home.

(*b*) Rubbish from previous Season's Crop: Owing to the high percentage of infection at the end of the season all tobacco-plant remains must be regarded as infected and capable of carrying the disease over to the next season. Therefore, after drying of the leaf is completed, all tobacco refuse should be collected from in and around the kilns and sheds and destroyed by burning.

(*c*) Cured Leaf: All saleable leaf should be disposed of at as early a date as possible. Unsold leaf should be stored and not left lying in the sheds. All discard leaf should be burnt as soon as grading is completed.

(*d*) Other Infected Hosts: Mosaic sometimes spreads to tobacco from infected tomato or black-nightshade plants.

If tomatoes are grown on the farm every care should be taken to see that they do not become infected. Thus all seed sown should be from

* Until such time as arrangements can be made to have tobacco sterilized in the Nelson District, growers may have their tobacco treated free of charge by forwarding it to the Plant Diseases Division, Box 16, Palmerston North. Factory-made cigarettes cannot be treated.

healthy plants and the same precautions taken as when dealing with tobacco. As the symptoms on tomatoes are sometimes very slight and may not be noticed, the hands should be thoroughly washed after working with this crop.

On account of the inconspicuous symptoms displayed, black nightshade may act as an unsuspected source of infection. Mosaic is more likely to be present on this plant because of the ability of the virus to carry over in the seed. Special care should be paid to the eradication of this weed in the seedling-beds and surroundings. If plants are pulled the hands should be washed before again working with tobacco.

B. Prevention of Spread after Infection has taken Place.

Once tobacco-mosaic has been introduced it may spread rapidly through the crop. Spread takes place through the soil and by workmen.

(1) *Through the Soil.*—Although tobacco-mosaic is not known to pass from diseased to healthy plants directly through the soil, it does spread from infected plants to healthy replants. It is suggested, therefore, that when making replants the infected plant be removed complete with a large shovel-full of surrounding soil. Before replanting the hole should be filled with soil from between the rows.

(2) *By Workmen.*—This is the commonest method of spread of tobacco-mosaic. Unless a great deal of care is taken each operation which entails handling of the plants may bring about a marked increase in the amount of the disease.

Before pulling plants for setting out in the field the seedling-beds should be carefully inspected. If only a few infected plants are found, these, together with a group of surrounding plants, should be removed and destroyed. Where there are many infected plants in a bed it is inadvisable to set out any plants from it. The person doing the pulling should watch carefully for diseased plants, and when one is discovered it and a group of healthy plants surrounding it should be left unpulled. If an infected plant is accidentally pulled the person who has handled it should wash his hands before taking out any more healthy plants.

After plants have become established in the field they should be carefully inspected for mosaic. Plants showing infection at this stage do not produce any saleable leaf, and furthermore act as a potent source of infection for the rest of the crop. They should be removed and destroyed and their places filled with healthy replants. Several inspections should be made at seven- to ten-day intervals.

The disease may be spread on implements during cultivation, so as much care as possible should be taken to prevent them from rubbing against the plants.

If tobacco-mosaic is present in a crop a great deal of spread is liable to take place during topping and lateraling operations. To keep the amount of spread down to a minimum, one person should go through the crop ahead of the rest of the workmen and top or lateral all infected plants. This should be practised even late in the season when it is considered that mosaic will no longer affect the yield or quality of the crop, for, by keeping down the amount of infection, there will be less disease to carry through to the next season.

During all stages of growth of the crop workmen should be careful to thoroughly wash their hands after handling diseased plants. To be effective washing must be very thorough, it being advisable to use warm water, a nail-brush, and plenty of soap. After washing, the hands should be rinsed in running water or a change of water.

Summary of Control Measures.

(1) Use steam-disinfected soil in the seed-boxes.

(2) Do not use a seedling-bed for a second season if tobacco-mosaic has been found therein.

(3) Establish new beds on ground which has not been in tobacco or tomatoes for at least two years.

(4) Keep the beds and surroundings free from weeds and stray tobacco-plants.

(5) Inspect seedling-beds prior to pulling plants for field planting, and remove and destroy any infected plants. If much mosaic is present in a bed do not set out any plants from it.

(6) Workers handling plants should smoke only sterilized tobacco or be non-smokers.

(7) Avoid contamination from other hosts. To this end keep tomatoes free from mosaic and eradicate black-nightshade plants.

(8) Remove and destroy diseased tobacco-plants as soon as they are noticed in the field.

(9) Remove the soil surrounding the infected plants when replacing them and fill in with clean soil before replanting.

(10) Avoid handling infected plants when working with healthy ones.

(11) Thoroughly wash the hands with soap and water to remove contamination whenever infected plants have been handled.

(12) Plough out roots and remove them from the field, together with stems and old leaves, and destroy by burning.

(13) Destroy all discard leaf as soon as possible after curing and grading is completed.

(14) Remove all tobacco from the farm at as early a date as possible.

In a strain trial at Palmerston the influence of clover on the relative value of cocksfoot and rye-grass is very marked. Throughout the major portion of the trial, which was sown with a mixture of grasses and clovers, there is a good healthy mixed sward, with rye-grass the dominant and best producing grass. Cocksfoot is present, but compared with the rye-grass is of much less value. On the "no clover" plot rye-grass is also dominant as regards ground cover, but cocksfoot is much the better producer and in the circumstances is the better grass. All plots have been liberally top-dressed with lime and super. This top-dressing appears to be thrown away as far as the "no clover" plot is concerned at present.—*Fields Division.*

SEASONAL NOTES.

THE FARM.

Special Feed Provision of Seasonal Importance.

A SEASONAL matter of great moment is consideration of the steps to be taken during the coming year in regard to the provision of special feed to supplement the pastures during those periods when the feed directly available from pastures is likely to be below the economic requirements of the number of stock that should be carried to bring about advantageous consumption of the main supply of feed, which is that harvested directly by the animals themselves from the pastures.

In considering this matter the dairy-farmer is confronted by two major facts. Firstly, even the average dairy cow calls for a higher standard of feeding than do other classes of cattle or sheep, while the good dairy cow is particularly exacting and exceptional in its requirements. One reason for this emerges clearly from a comparison of the requirements of the breeding-ewe and the dairy cow. Like the dairy cow the breeding-ewe calls for liberal supplies of high-quality milk-producing feed in preparation for and during the period of its useful production of milk. The vital difference between the cow and the ewe is that the milk-production of the cow should continue at a relatively high level for several months after that of the ewe, and this in the latter part of the summer and autumn, when the pastures frequently do not readily or naturally provide feed that is fully suitable for a high level of milk-production. Another reason for the comparatively high standard of feeding required by the dairy cow lies in its high standard of production. An indication of this is obtained by comparing the steer putting on the satisfactory daily gain of 2 lb. live weight and the cow giving the moderate yield of 3 gallons of milk daily; the former elaborates from its food 1½ lb. of dry matter daily, the latter 3¾ lb. daily—two and a half times as much. It is notorious that the good dairy cow frequently is fed substantially below its economic requirements. The facts just considered assist in explaining why this is so. The modern good dairy cow is a relatively recent development in the world's farming. Hence, in the evolution of traditional live-stock feeding practice the needs of the modern dairy cow were not taken into account—indeed, they could not be taken into account, for the counterpart of the modern dairy cow did not exist. Hence it follows that the experience which taught how to feed well either cattle—as just cattle—or sheep is far from enlightening as to the needs of the dairy cow. Better feeding of good dairy cows may be expected to arise from fuller and wider realization of their special needs.

The second fact of importance in regard to the dairy-farmers' provision of feed is that the well-managed sow is in an important respect more exacting than the good cow in its requirements of feed. This originates in the fact that in the feed-supply needed by a sow which rears two litters annually there are two peak periods, and while one of these may coincide with the period when cheap supplies of pig-feed, such as dairy by-products, are most freely available, both of them of necessity cannot do so. Further, the sow, because of physiological differences between the sow and the cow, should receive feed of even better quality, in respect to high digestibility and low content of fibre, than that given the dairy cow. Summed up, in the cow and the sow the dairy-farmer handles stock which require a feed-supply (*a*) that should be of comparatively generous quantity and good quality, and (*b*) that should be maintained for an exceptionally large part

of the whole year. These two features of the dairying feed-supply should be given close attention in planning the year's production of feed. In this connection a point of basic importance is that the variations from month to month in the feed requirements of stock do not correspond with the variations in the direct yield of feed from month to month by typical grassland.

There is evidence that many sheep-farmers profitably could make greater provision of special supplementary feed than they are accustomed to make. It is well known that lambing percentages are affected materially by the condition of the ewes at service. It is known that superior results are obtained when "flushing" of the ewes is carried out—*i.e.*, when the ewes are in rapidly improving condition when they are served. In some districts favoured by timely rains the growth of grassland allows of flushing to occur almost naturally and with a minimum of effort on the part of the farmer to bring it about. But in districts with a climate similar to that of much of the Central Hawke's Bay or of Canterbury flushing usually calls for the use of feed specially provided for the purpose. Recent investigations in Hawke's Bay point to the possiblity of increasing the lambing percentages at times by 6 per cent. to 10 per cent. by suitable flushing. In limited experience in the South Island, under irrigation which facilitates the provision of flushing-feed, even greater increases in lambing percentages have been credited to flushing.

Relative to the provision of special supplementary feed, many sheep-farmers probably with advantage could give more attention to the fact that lambs that are kept thriving are seldom troubled seriously with internal parasites. Since at least the beginning of this century, veterinarians and others have pointed to the value of good feeding in lessening the ravages of such parasites. The position recently has been stated strikingly by Dr. Fraser, of Rowett Institute, Aberdeen, thus: "My considered advice is to look after the sheep, and the sheep will look after the worms." While this is not advanced as a full statement of the position, in so far as it relates to proper feeding, it is in accord with the advice of New Zealand authorities.

The winter feeding of breeding-ewes often could be improved with profit. A direct step towards such improvement would be additional provision of special feed to supplement the pastures. There is evidence that improved winter feeding of ewes at times would lessen troubles and losses at lambing, and that it would increase the number and the weight of the lambs fattened "off the mothers."

The foregoing remarks are designed to indicate the practical importance to both the sheep-farmer and the dairy-farmer of the proper provision of special supplementary feed with the object of making the supply correspond with the requirements of feed from season to season throughout the year. On all farms, except those on which arable crops are dominant, the question of special supplementary feed is indeed of prime importance at this time of the year. Measures which can be made to assist greatly in meeting the position—ensilage and special cropping—are ones for which preparation usually should be in progress about this time.

Ensilage.

The two main tasks relative to ensilage that at this stage call for attention are—

(1) *The Closing of Suitable Pastures.*—There should be no delay in the closing of fields for silage. A common error is the making of silage at a later date than is desirable. One of the advantages of ensilage in comparison with hay-making is that silage usually may be removed early enough to allow of a substantial leafy aftermath before the customary dry summer period during which such an aftermath frequently is especially useful. As a rule, it is profitable to top-dress fields with superphosphate just before closing them for hay or silage if they have not been top-dressed during the previous year.

(2) *The Construction of Pits or Trenches if these are still to be farmed.*—Suitable sites are to be found on a great many farms for pits or trenches, which usually can be made quite inexpensively. Hence, as a rule, it is not difficult to provide sufficient pits or trenches located at different points on the farm in such a way that the necessity for using the same pastures frequently for ensilage may readily be avoided. If convenient terraces on which pits can suitably be placed are not available, then trenches which quite satisfactorily can be located on level paddocks may be employed. In trenches, which are simply shallow pits, silage has been saved with the wastage so slight as to be immaterial. When the pit or trench method of ensilage can be adopted it usually should be followed, as it not only minimizes wastage of crop material, but also lessens the amount of labour and equipment required. Trenches have been used successfully in soils which are far from well drained—*e.g.*, heavy level soils in districts of 40 in. to 50 in. of rainfall annually and with no artificial drainage, but despite such experience it is naturally advisable to avoid as much as possible poorly drained sites for trenches, as bad drainage in the vicinity of the sites tend to hamper the carting out of the silage for feeding.

The plans for the production of special feed often quite well may provide for haymaking as well as ensilage. When surplus grass is being harvested during good haymaking weather, it is then good practice to turn such grass into hay instead of silage; hay is more suitable than silage for feeding in conjunction with roots, which should be used on many of the farms on which ensilage also is well worth while.

Special Forage Crops.

Often the needs in respect to special supplementary feed cannot be met fully by ensilage and haymaking. In sheep-farming the flushing of ewes or the feeding of hoggets possibly may be best carried out by the use of special crops. In dairying the provision of sufficient highly digestible feed in the latter part of the summer is particularly important; at times the feed available directly from grassland commences to fail shortly after Christmas as a ration for reasonably productive dairy stock. While it is not difficult to supplement the pastures suitably during the latter part of January and in February, it is not altogether easy always to remedy the weak position that occurs a little earlier. Fresh leafy growth such as an aftermath on an ensilage field or a second growth on a lucerne area are likely to be specially useful at this period. When there is no certainty of sufficient leafy feed from such sources, it generally is advisable to sow in October an area of quickly maturing soft turnips, such as Purple Top Mammoth, for use early in the New Year.

In general at this time of the year it is particularly desirable to push ahead as rapidly as possible with the preparatory work for such crops as mangels, rape, chou moellier, and other kales, lucerne, and swedes. There is much evidence from the field that the thoroughness of cultivation is more frequently and more gravely a limiting factor in crop-yields than is commonly believed, that full benefit is not received from good seed and suitable fertilizers because the cultivation is the weak link in the chain of factors that constitute efficient crop-culture.

The acreage devoted to the mangel in the Dominion in 1935–36 was higher than usual, but sales of seed suggest that a decrease in acreage took place last season. Having regard to all the current circumstances the mangel actually warrants increased rather than decreased attention. Over a wide range of conditions efficient culture results consistently in yields of 50 tons or more of mangels an acre. It is of seasonal importance that success with the mangel depends upon high fertility and thorough cultivation. Hence, if land intended for mangels is not naturally rich it should be made so by

the use of farm or artificial manure or both, and due attention should be given to the fact that the mangel responds profitably to abundant and thorough cultivation both before and after the sowing of seed.

Chou moellier or marrow stemmed kales and other kales have at times been sown in October with good results for the provision of feed from the middle of January or the beginning of February. Later sowings to provide feed in the following autumn and winter are usually advisable. Chou moellier continues popular among both sheep-farmers and dairy-farmers. It requires the soil conditions which suit the cabbage—*i.e.*, high fertility, which it well repays. It usually responds profitably to a dressing of 2 cwt. to 3 cwt. an acre of superphosphate on good land, a dressing which as a rule it is advisable to supplement with 2 cwt. to 3 cwt. an acre of blood and bone on poorish land which has not been enriched by farmyard or similar material that is excellent for chou moellier. The popularity of chou moellier is due not only to its good feeding and good potential yield, but also to the three following facts: (1) Its total labour requirement is relatively small; (2) it is highly resistant, though not immune, to club-root, and so can be grown safely where swedes would fail because of the ravages of club root; (3) it can be fed *in situ* with the minimum of waste under wet conditions in the winter.

On free soils the carrot proves distinctly productive and useful under suitable management. Of the roots commonly grown the carrot has the greatest feeding-value per ton, and yields of over 40 tons an acre are not at all uncommon. The Guerande variety rightly appeals to many because it may be grown in such a manner that thinning is inadvisable, and, because of its habit of growth, digging is unnecessary. Ordinarily it should be grown at the rate of 1 lb. to 1½ lb. of seed an acre, in rows 18 in. to 24 in. apart, and intercultivated as much as possible, but it may be grown without intercultivation when sown at the rate of 1½ lb. of seed an acre in rows 14 in. apart. It is considered good practice, especially for sheep, to sow it on low ridges obtained by rolling after the ordinary ridger. Other varieties popular because of their consistently good yields are Matchless White, Barriball, and White Belgian. Preparatory cultivation is most generally commenced between mid-August and mid-October. The seeding usually adopted is 1 lb. to 1½ lb. of seed an acre in drills 14 in. apart, but very good yields have resulted from sowing in drills 18 in. to 24 in. apart. A popular manurial dressing is a mixture of superphosphate and bonedust at the rate of about 4 cwt. an acre.

Preparatory cultivation for lucerne, if not already in progress, should be started without delay. Though the area of lucerne in the Dominion has increased by about 50 per cent. in the past decade, lucerne could, with much profit, be grown very much more widely in both the North Island and the South Island. Much information about the establishment and the general culture of lucerne is given in Bulletin No. 155, which may be obtained free on application to any office of the Department of Agriculture. The appeal of the crop is particularly wide, as it has been used with good results in New Zealand in the feeding of sheep, cattle, pigs, poultry, and horses. The history of lucerne-culture in New Zealand contains many instances of failures, which in the light of the knowledge now available could have been avoided easily—indeed, at times the practices adopted with lucerne were fitted to beget failure rather than success. Because of the later additions to our knowledge, lucerne to-day is being grown successfully over a wide range of soils and climates in New Zealand.

The Potato Crop.

In many districts the main crop of potatoes should be sown in October Of outstanding importance is the use of "seed" healthy in all respects. The most serious form of disease is carried in the tubers. Knowledge of

this form of disease is incomplete—no visible causative organism is known—and the term virus is applied to it. Several forms of virus disease are known, and an important feature common to them all is that while the symptoms can be seen readily in the foliage they cannot be seen in the tubers, and so it is impossible to tell by inspection of "seed" whether it is healthy or suffering from a virus. The official seed-certification carried out by the Department of Agriculture gives much attention to the amount of virus visible in the foliage of the parent crop at the time of field inspection, the objective being to make available lines of potato "seed" with relatively small amounts of virus infection. Hence, as a rule, the only safe course is the use of certified seed from crops where the virus incidence is known to be small. A concrete illustration of the value of certified seed is given in official data published by the Government Statistician, and based on returns supplied by farmers. The data relate to 10,000 acres—the total Dominion crop approximates 22,000 acres—grown throughout the Dominion, about one-quarter of this 10,000 acres being in certified seed, the average yield an acre from certified seed being 7·43 tons, while from uncertified seed it was 5·05 tons. Hence an increase of 25 per cent. in yield is associated with the use of certified seed.

The following varieties are of well-established merit: Aucklander Short Top (usually grown in the North Island as Sutton's Supreme), a second early which rightly is very popular, since it consistently gives satisfactory yields of good keeping and cooking quality, but it bruises rather easily in handling; Aucklander Tall Top, similar to Aucklander Short Top, except that it is later, being a main crop; Dakota, a standard main-crop variety that generally does well on medium land in Canterbury; Arran Chief, good lines of which should be popular on heavier land; King Edward, a potato of outstanding quality, which in general has not yielded satisfactorily except in Southland; Epicure, an early variety which can be recommended when certified seed is to be used.

—R. P. Connell, Land Utilization Officer.

THE ORCHARD.

Spraying.

No hard and fast rules can be laid down for the spraying of fruit-trees, as the programme to be followed largely depends on the climatic conditions prevailing during the season. The following general programme, giving the different periods of application and strengths of the sprays recommended, should act as a guide to growers.

The first application of spray after the trees have commenced growth, known as "foundation spray," is most important, and on no account should be omitted by growers. The first spray should be applied during the month of September, the dates varying in the different districts:—

Apples:—

(1) Green-tip Period: Bordeaux mixture 5–4–50; lime-sulphur 0·5 per cent. (1–30).

(2) Open-cluster Period: Lime-sulphur 0·2 per cent. (1–75); or lime-sulphur (1–50) plus colloidal sulphur 2–100.

(3) Petal-fall Period: Lime-sulphur 0·1 per cent. (1–500) plus colloidal sulphur 2–100 plus lead arsenate 1½–100 plus hydrated lime 3–100.

(4) Ten to Twelve Days later: Same as No. 3.

(5) Fifteen to Eighteen Days later: Lime-sulphur 0·083 per cent. (1–180) plus colloidal sulphur 2–100 plus lead arsenate 1½–100 plus hydrated lime 3–100.

(6) Subsequently at Fifteen to Twenty Days' Intervals till Mid-January, and later if necessary: Same as No. 5.

The dilutions given in these notes for lime-sulphur refers to a specific containing 15 per cent. of polysulphide content, calculated on the basis of weight. During January and February apply summer-oil at strength 1–100 to 1–150. Two applications at close intervals for the control of red mite, &c. These sprays should not be applied within fourteen days of sulphur sprays.

Slight variations can be made from the above programme when spraying special varieties. For instance, with Cox's Orange Pippin lime-sulphur can be dropped after the first two sprays, using colloidal sulphur at strength 2–100, reducing to 1–100 as the season advances. With Jonathan and Dunn's Favourite colloidal sulphur may be substituted for lime-sulphur according to weather conditions.

Pears :—

(1) Green-tip: Bordeaux mixture 5–4–50.
(2) Pink Period: Bordeaux mixture 3–4–50.
(3) Fruit-set Period: Bordeaux mixture 3–4–50 plus lead arsenate $1\frac{1}{2}$–100.
(4) Later, at Intervals: Lime-sulphur 1–180 plus lead arsenate $1\frac{1}{2}$–100.

Exception can be made with the Winter Cole, P. Barry, and Josephine varieties, the following sprays being recommended :—

(1) Green-tip: Bordeaux mixture 3–4–50.
(2) Pink Period: Lime-sulphur 1–75.
(3) Fruit-set Period: Lime-sulphur 1–180 plus lead arsenate $1\frac{1}{2}$–100
(4) Later, at Intervals: Same as No. 3.

Stone-fruits :—

(1) Bud-movement Period: Bordeaux mixture 5–4–50.
(2) Pink Period: Bordeaux mixture 3–4–50 or lime sulphur 1–100.
(3) Fruit-set Period: Lime-sulphur 1–180 plus colloidal sulphur 2–100.
(4) Intervals: Same as No. 3.

During January and February it may be advisable to apply nicotine sulphate at strength 1–800 plus 3 lb. soft soap for the control of black and green aphis, repeating the application in seven to ten days.

Cultivation and Manuring.

Ploughings, whether autumn or spring, should now be receiving attention if the best results are to be obtained. The breaking-down of the soil by disk, harrow, and cultivator does much to aerate the soil and to create a fine tilth so necessary during any dry periods that may follow during the growing-season. Cultivation round the trees is an important operation too often neglected. The thorough working of the soil at this time of the year not only makes cultivation much easier during the balance of the season, but has a great influence on the growth of the trees and the crops carried. Every effort should be made to harrow the orchard after rain to break the crust, to prevent drying out, and to promote capillarity between topsoil and subsoil so necessary for the welfare of the trees. Further delay in the application of manures may mean that the trees will not receive the benefits to be expected during the present growing-period.

Planting.

New plantings should be proceeded with as soon as the soil is in a suitable condition to receive the trees. Should the ground be cold and wet, it will be preferable to defer planting for a week or two to ensure that the young trees receive no setback at the start. All broken and bruised roots should be cut off, and the top cut back sufficiently hard to form a good

framework for the future tree. The young trees should be placed on a slight mound within the hole so as to give the roots a downward inclination—roots well spaced and the soil well pressed round the roots. The trees should be planted firmly. A small application of blood and bone manure mixed with the soil to be used for filling in the hole will materially help in giving the roots a good start for the coming season.

Grafting.

The time for the renovation of fruit-trees by means of grafting is now approaching; in fact, providing the season is suitable, grafting may be done in some parts towards the end of September, but, as the majority of the work is done in October, further notes on this subject will appear next month. It is necessary to see that the scions to be used in the operations are kept in a dormant condition, free from disease, and that the buds, from which the new growths will start, are in a healthy condition.

—George Stratford, Orchard Instructor, Motueka.

Citrus Culture.

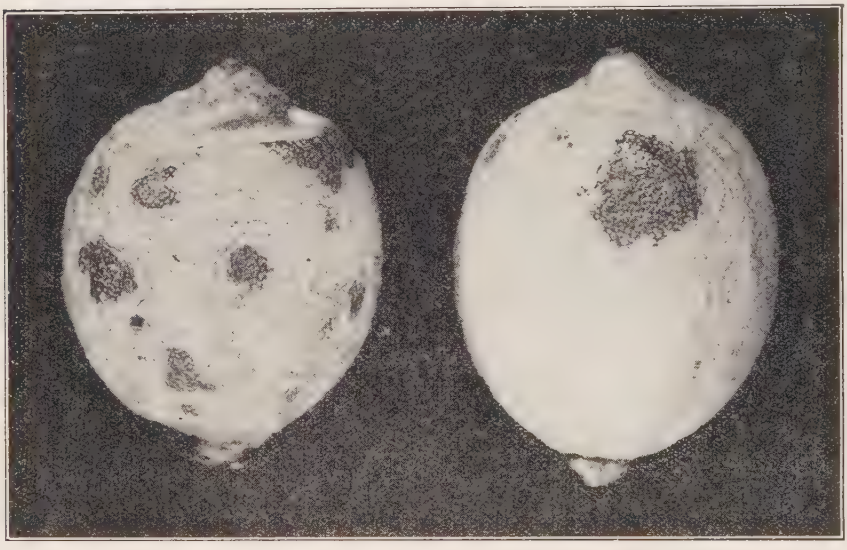
Reworking.—Most lemon and orange orchards contain a number of trees that produce fruit of an inferior type consistently year after year. Although a percentage of the fruit from such trees may be marketable, it is seldom wise to retain such trees. In most cases it is best to work the trees over with buds taken from trees that consistently produce heavy crops of high-quality fruit. The same recommendation applies in the case of unsuitable varieties.

The standard method of propagating citrus is by budding, which is much simpler, quicker, and more economical of budwood than any method of grafting. Citrus can be budded whenever the bark will lift, which can be expected in the months of November and March. Unlike that of stone-fruits, two-year-old wood of citrus is quite suitable for budding, and often buds inserted into limbs that are three and four years old will prove satisfactory. However, one-year growth that is well matured will usually give best results. When it becomes necessary to rework mature trees, the best method is to remove all limbs about 1 ft. above the main fork of the tree. This should be done as soon as the spring growth commences, although where this is not possible the work of cutting back can be proceeded with until several months later. The vigorous shoot-growth that arises from the remaining portion of the tree should be sufficiently mature to receive the buds before growth ceases the following autumn. These shoots are then thinned to the required number and the buds inserted near the base of the shoots. Greater care and skill is required in the budding of citrus than in most other kinds of fruit-trees, and even under ideal conditions a skilled operator will seldom secure 100 per cent. of "takes."

Budding is accomplished by the insertion of a shield-shaped bud into a "T" or an inverted "T" slot cut in the bark of the one-year shoots. It is claimed that the latter method keeps out the moisture better. A sharp knife is essential. The bark is then lifted slightly at the junction of the vertical and horizontal cuts. The bud is next cut from a stick of mature one-year wood, with the basal end held away from the operator. The cut is made towards the operator with the knife blade almost parallel to the axis of the bud-wood. This will give a shield-shaped piece of bark and wood about ¾ in. to 1 in. long, with a smooth and flat cut surface. The wood portion should not be "scooped" out. The bud is inserted beneath the bark and then pushed as far as possible along the vertical cut in the stock.

In selecting bud-wood, well matured plump shoots of the type that usually produce fruit should be selected. Flat or angular growth is undesirable, likewise vigorous water-shoots.

A good grade of calico torn into strips about ½ in. wide and impregnated with grafting-wax is excellent for wrapping. The binding is started below the bud and the calico is wrapped firmly in a spiral manner until the entire length of the vertical cut is covered. The actual bud is completely covered in the process. After about fourteen to seventeen days the bud is examined, and if still green and showing callous formation the binding can be removed. Any failures can be rebudded immediately if the bark still lifts readily. If the bark by this time is adhering to the wood, further budding must be delayed until the spring growth commences. When the bud is inserted in the autumn the top is removed as soon as the spring growth commences by cutting just above the bud, and with spring budding as soon as the binding is removed.



THE COMMON FORM OF GREEN-SPOT.

"Green-spot" is the name given to markings which are often produced on lemons that are harvested when of a green or silver colour. The spots usually vary from a ¼ in. to ¾ in. in diameter, and are caused by the fruit becoming bruised at some stage before it is fully coloured. These bruises, when made, are not readily seen, except under close examination, consequently growers not curing their own fruit often fail to realize that such injuries have occurred. Fruit that is picked when in a wet condition is believed to be most readily affected. The accompanying photograph illustrates the common form of green spot.

Blue-mould (Penicillium italicum).—This fungus disease often causes considerable loss in citrus fruits both during the curing and in the interval between the packing and the sale of the fruit. During the months of October and November the disease is usually most troublesome, consequently special care should be taken with all fruit harvested at this time of the year. The fungus cannot enter a sound fruit unless it comes in actual contact with a decayed fruit. However, the slightest injury to the oil-cells is sufficient to allow the fungi to gain an entrance

to the tissues of the fruit. These injuries are so small at times as to be invisible to the naked eye. Lemons that are harvested in a yellow condition are particularly susceptible to attack. There is a tendency on the part of some lemon-growers to allow small fruits to remain on the trees for several weeks after assuming the silver-green colour, particularly during the late winter and spring months. Little, if any, size-increase takes place in the fruit by this practice, and the risk of blue-mould infection is greatly increased.

—*P. Everett, Orchard Instructor, Gisborne.*

POULTRY-KEEPING.

Determination of Sex.

SEVERAL inquiries as to whether sexing is injurious have been received. In this connection it may be mentioned that in order to test out the effect of this operation the Department had a batch of chickens sexed on the 2nd September, 1935. The sexed pullets were reared separately. The average weight of the 204 one-day-old sexed pullets was 1·33 oz., as against an average weight of 1·47 oz. for 274 one-day-old mixed White Leghorn chickens, which would indicate that one-day-old cockerels are slightly heavier than one-day-old pullets. At six weeks old the 126 pullets which had been reared with cockerels averaged only 10·39 oz., as against an average of 12·66 oz. for the sexed pullets; thus showing that the sexed pullets grew better when reared by themselves. It would also indicate that sexing had no ill effects.

The approximate cost of feeding the chickens up to six weeks old was 2½d. each.

Forty of the sexed pullets, which were reared on a dry mash, were kept separate, and comprised one of five pens of forty pullets each. Each pen of birds was fed on a different ration, and the pen of sexed pullets laid more eggs during the test than any of the other four pens, which were made up of pullets that had not been sexed. After the test was over some of the birds were culled on account of their not being up to standard, just as any flock requires to be culled.

The rest of the hens are now entering their second laying-season, and they have shown no ill effects from the action of sexing.

It may be of interest to mention that the cockerels sexed from the batch of chickens in question were sold as day-olds. The purchaser reared them and kept the best for breeding purposes, and the results were quite satisfactory.

Judging from these tests, together with reports from poultry-keepers who have had large numbers of chickens sexed, it may be said that provided the work is done by careful, experienced operators, there is little danger of any ill effects.

In order to diagnose the sex of one-day-old chickens accurately and quickly, a person requires to be in practice, have good eye-sight, plenty of light, and a retentive memory. It is quite possible for an inexperienced person, especially if the light or eye-sight is not too good, to cause injury by applying too much pressure when sexing, and for this reason poultry-keepers would be wise to see that competent certificated persons only are engaged to do the work. At times, if ovarian trouble is experienced amongst sexed pullets, there is a tendency to think that the birds were injured while being sexed. Experience has shown, however, that if injury is done while diagnosing the sex the injured birds do not live long.

Vent-picking.

Vent-picking is usually started by one hen picking the vent of another whilst it is in the act of laying. The picking causes bleeding and laying keeps the wound open. Protrusion of the oviduct often follows, or the wound becomes septic, when a whitish discharge comes from the vent. One bird will often start the trouble and cause almost an epidemic in a flock, for once birds acquire the taste for blood they seem to watch for other birds laying and then attack them.

Treatment of victims is of little value. The best plan is to remove the culprit at once, if possible darken the nests, and keep the birds busy by increasing the depth of litter and scattering a little scratch feed about during the morning.

The Season getting on.

On a general farm where only a small flock of poultry is kept and the hatching and rearing are done by natural means it is often difficult to get broody hens before this time. However, if not already done, every effort should be made to get all the chickens required hatched out as soon as possible.

September is looked upon as the best month of the year in which to hatch chickens, although many prefer August for hatching out chickens of the heavy breeds. Most of the large poultry-farmers try to get all their stock hatched out before the end of September, as experience has shown that, where large numbers of chickens are raised artificially, those hatched after September do not do so well, especially if the months of October and November are dry and warm. October hen-hatched chickens, especially of the light breeds, provided they are reared on fresh, sweet ground and are well looked after, should come into profit during April, but later-hatched birds do not as a rule do well, and seldom come into profit until the winter is over and eggs are cheap.

Selecting Broody Hens.

As all broody hens do not make satisfactory sitters or mothers, care should be taken to select those of a quiet, docile temperament, and avoid the wild, nervous birds. Some hens are naturally clumsy, while others will sit for a day or two and then leave the nest, so for these reasons it is advisable to set the hen on some dummy eggs for a few days, and when satisfied the bird is really broody and of a gentle, quiet temperament, the more valuable eggs should be placed under her.

It is never advisable to set broody hens in the fowl-house or laying-shed, where they are liable to be disturbed by other hens, and where they are more likely to become infested with insects. The better plan is to build a light coop, with run attached, which can be moved on to fresh ground regularly. Such a coop can be cheaply erected and should give good service for a long time.

As more hen-hatched chickens and young turkeys are lost each year from the ravages of insects than from any other cause, it is advisable to see that all broody hens are treated for insects. A simple and effective method is to dip the end of a feather into nicotine sulphate and draw this under both wings and amongst the breast feathers, or dust the bird with insect-powder. This should be done when the bird is first set, and again in about ten days' time, but it is not safe to treat birds with chickens, or sitting hens just before the hatch comes off. The nest is best made on the ground, in order that the eggs may get moisture, otherwise the skin inside the shell is liable to become too dry and tough for the chicken to cut through. Make

the nest saucer-shaped, flat on the bottom, and just deep enough to cause the eggs to have a tendency to roll towards the centre, and flat enough to prevent them from piling up when the hen turns them.

Plenty of soft, pliable nesting-material, such as oat-straw or pine-needles, should be used. Should an egg get broken and the contents become smeared over other eggs, it is advisable to wash them in warm water and renew the nesting-material.

If sitting hens are closed in a coop or box, care should be taken to see that plenty of fresh air is available. They should be allowed to come off once a day. Grain, water, and grit are all in the way of food that sitting hens require. It is better to avoid giving mashes, especially sloppy food, as such are likely to cause looseness of the bowels, and the eggs to thus become soiled. The less sitting hens are disturbed the better, especially at hatching-time.

It seldom pays to help chickens out of the shells.

Feeding and Care.

There are many different methods of feeding chickens, and in many cases success depends more upon how the birds are fed and cared for than upon what is fed. They should be fed at fixed times and at regular intervals, the first feed as early as possible in the morning and the last just before dusk. Feed fully and give plenty, but do not leave food lying about to become sour.

Chickens can only be expected to do well when their quarters are kept dry and clean. Dampness is dangerous as it is likely to cause filth from droppings, and disease may result.

As stale ground is responsible for a great deal of unthriftiness, it is advisable to arrange for chickens to be reared on fresh ground, apart from where adult birds have been running.

Those desiring full particulars of two methods of feeding chickens which have given good results at the Wallaceville Poultry Station may secure copies of same on application to the writer.

—C. J. C. Cussen, Chief Poultry Instructor, Wellington.

THE APIARY.

Feeding and Water.

A CONSTANT watch should be kept on the stores in the hives. Usually at this period there is a steady drain on the food-supply to meet the incessant demand for brood-rearing. If an examination of the hives was carried out, as advised in my July and August notes, then the losses attendant upon spring starvation will have been avoided ; but it is not wise to neglect to feed where stores are short, as the spring is the most critical period for the beekeeper. The weather conditions are not always favourable for the bees to work the early spring blossoms, and in populous colonies the food-supply should be augmented, but only where there is a noticeable shortage. If there is a good queen in the hive she will usually begin laying as fast as weather conditions will permit, and it is a mistake to start feeding unless stores are very short, as it stimulates brood-rearing, and, when commenced, must be carried on until a natural flow sets in from the fields.

Abundance of stores is certainly required at this season, and if the beekeeper finds that additional food is required, it can be supplied in the form of combs of honey or as a syrup. The feeding of combs of

honey should not be practised unless the beekeeper is sure that his apiary is free from disease, as there is always danger of spreading disease by this method. No better substitute for honey has been found than cane-sugar, and it is far safer to use it at all times if the beekeeper is not satisfied as to the health condition of his apiary. Honey from an unknown source should never be fed. There are many feeders on the market. The division-board feeder is the best to use at this season, as it will serve the double purpose of feeder and division-board in cases where the colony is not strong enough to occupy all the frames in the hive.

In the spring months, when brood-rearing is at its height, bees require a good supply of clean water in the apiary. If this is not provided they are apt to become a source of annoyance at drinking-troughs and by congregating round domestic supplies. The brood requires a great deal of water in addition to pollen and honey. The amount depends largely on how much brood-rearing is going on, and to what extent nectar is coming in from the fields. If water is not close at hand many bees are lost in trying to obtain it, more especially as the weather is often changeable and boisterous in the spring.

Many simple contrivances can be made to supply water. "Simplicity" feeders make excellent vessels for the purpose, but they require to be filled frequently. To start the bees taking water from any particular place it is a good plan to slightly sweeten the first water given.

When to start an Apiary.

One of the questions most frequently asked by the would-be beekeeper is, "When should I start beekeeping?" Probably no time is better than when the bees are swarming. If the beginner procures a good prime swarm, leaves it in a clean box for three days, and then hives it in a new hive, on new frames, with full sheets of foundation, he has made the best start it is possible to make in beekeeping. The leaving of the swarm in a box for three days is purely a preliminary measure in case there is any disease in the apiary, from which the swarm is procured. By the end of three days the bees will have consumed the honey they brought from their old home, and at the same time have disposed of the foul-brood germs (which are innocuous to the adult bee), and be ready and willing to be transferred to their permanent home to start brood-rearing in earnest.

As the bees will have become used to their box by the end of three days, it is as well to carry out the transfer with care. It should be done at sundown on the third day. The hive should be placed in position, a clean sack spread over the alighting-board and surrounding ground, and the hive-body raised from the bottom-board about an inch or so by means of a stone or piece of wood. The box should be firmly grasped with both hands, inverted over the sack as near the hive as possible, and the bees dumped with a brisk movement on to the alighting-board. One shake will dislodge the greater part of the cluster, and the few remaining bees can easily be shaken out and the box taken away. Be sure the queen is out of the swarm-box, and the bees will crawl in a steady stream into the entrance, their progress becoming more rapid as soon as the queen has entered the hive. When the queen is safely inside, the hive body should be lowered and the entrance slightly contracted.

It is advisable to place a feeder inside the hive. Even if the weather is good and a fair supply of nectar available, a few pints of good warm syrup fed a day or two after hiving will work magic with the new colony, and enable it to build up in time to yield a surplus when the main flow sets in.

The beginner should always start in the spring, and on no account should he attempt to commence with established colonies unless they are purchased from a breeder who guarantees his bees to be clean. Old hives are too apt to be homes of disease, and are only fit to be handled by the experienced apiarist.

—E. A. Earp, Senior Apiarist.

HORTICULTURE.

Vegetable Crops.

THE sowings for the month of October include the half-hardy crops of dwarf and runner beans, marrows, pumpkins, and cucumbers, also the winter crops of savoy and red cabbage, kale, cauliflower, and broccoli for planting out early in the new year. In districts where the season is not sufficiently long to grow an autumn-sown crop of red beet, a good main-crop sowing may now be made for winter use.

The beans may be used green, in the pod, or shelled, or dry; in the latter form the white, light-green, and pale-dun haricots are a popular nutritious vegetable available throughout the winter months. A light, rich, warm soil is most suitable for this crop, and where lime has been used a dressing of 1 oz. or 2 oz. of superphosphate to the square yard will be beneficial. Sow thinly so that plants stand at intervals of 3 in. or 4 in., and leave 2 ft. between the rows of dwarf varieties. Drills are made 2 in. or 3 in. deep, the latter being adopted where the land is light. The runner bean, a different botanical species to the preceding, is a perennial plant, and may be cropped for two or three years before resowing in a fresh locality.

The soil required by the gourds is very similar, rich in humus, moist, but well drained. Cucumbers may be sown to stand 12 in. to 18 in. apart and 5 ft. to 6 ft. between rows, marrows and pumpkins 3 ft. to 4 ft. between plants, with a greater distance between rows for varieties with strong runners when planted on a rich soil. Marrows are best cut green for immediate use so soon as they are of sufficient size, and the pumpkins allowed to ripen off and stored for winter use. Seed-beds of cabbage and other plants of the same family will require close attention to keep them free from insect pests. It will be the easier if remnants of older crops of the same class are cleaned up promptly so that pests are not readily carried over to succeeding crops.

So soon as danger of frost is past, kumara, or sweet-potato plants, may be set out; this will be, in many instances, early in the month of November or even later, but it should be as soon as possible, as the crop requires a long season to give best results. Meanwhile the rooted shoots are kept heeled-in closely in a sheltered bed where they are readily protected with covers in severe weather.

The soil most suitable for this crop is light, moderately rich, and clean. Where the quantity of manures or fertilizers used is small, it is generally best placed beneath the ridges on which the plants are set; larger dressings should be broadcasted and turned under. Where there is a possibility of a dry season planting is best done on the flat, otherwise a low, broad ridge will be warmest and give best results. Plants are usually set 18 in. apart and 2½ ft. to 3 ft. between rows. Planting is best done after rain, but if the weather is dry the plants should be watered in.

With rising temperatures, especially where they reach over 60° F., growers of mushroom crops are finding difficulty in controlling insect

pests. It is the greater on the older establishments, where a rigorous system of plant hygiene has not been observed, and especially when the crop is grown in sheds from which insects may not readily be excluded and where effective fumigation cannot be given. The commoner pests are mushroom-flies (*Sciara*), manure-flies (*Phoridae*), and Springtails (*Collembola*). Where the house may be closed tight these pests can be destroyed by fumigating with nicotine, a half to one fluid ounce per thousand cubic feet; otherwise nicotine sulphate, one ounce to four gallons water, may be used as a spray. In this regard it should be noted two ounces of lime hydrate should be used in the place of the usual soap ingredient, which is injurious to the mushroom crop. Another remedy is dusting with a pyrethrum powder of the highest grade. These treatments destroy the insects but not the larvæ and therefore should be repeated at intervals of two or three days, as may be necessary, to destroy the flies as they emerge.

Small and Sundry Fruits.

Under glass the tomato crop will be setting the fruit and the success of this critical period of development depends very largely on maintaining a suitable atmosphere. Cold draughts, close humid conditions, and sudden changes are inimical. Watering when necessary should be done in the morning, excessively high or low temperatures should be anticipated and the ventilators adjusted to maintain a warm buoyant atmosphere. In warm districts a little ventilation will be required now even at night. Unless glasshouse crops can be given this close attention they are rarely profitable.

During the month of October, chiefly towards the end, the first batch of tomato-plants for outside cropping are usually planted. Set deep and firm, carefully avoiding injury to the stem, sturdy plants should do well if the land has been well prepared. Spacing, whether stakes or trellis is used, is generally 12 in. to 15 in. between plants and 3 ft. between rows.

Other half-hardy plants of this class which are planted outside at this time are passion-fruit, tree-tomatoes and Cape gooseberries, also melons and cucumber-plants which have been raised under glass. If they have been purchased or come from a distance it is as well to place them in the hardening-off frames for a while, to be sure of their condition before planting them out.

Rather more tender than the above-mentioned are peppers and egg-plants, which are planted out a fortnight or so later, when there is practically no danger of a damaging frost. With the greater interest now being taken in salads and fruit by the general public, these crops demand greater attention from commercial growers, with a rich light soil in really warm districts. The egg-plant, probably a native of India, has long been in cultivation, and has much the same cultural requirements as the tomato, except that it is more tender and requires a rather longer growing-season. For this reason they should be well advanced in growth before planting out; preferably they should be in pots so that transplanting will interfere with growth as little as possible; 2 ft. apart and 3 ft. between rows is usually suitable spacing. Peppers, or capsiums, probably originated in tropical America, and were among the many food plants introduced into Europe from that source after the great discovery. They require much the same attention as the preceding, but may be planted rather closer, the plants being set 18 in. apart with 30 in. to 3 ft. between the rows. There are a large number of varieties which may be roughly divided into those

with fruit which is "hot" or pungent as Tabasco, and Cayenne; and others which are known as "cool" or sweet, and are in demand for serving as stuffed peppers and use in salads.

Strawberries showing signs of a fair crop may now be given a dressing of nitrogenous manure with advantage just before applying the mulch. For the latter purpose clean, baled straw that has been weathered to destroy seeds is very suitable; rushes and pine-needles are sometimes used. To keep the berries free from grit thrown up by splashing rain something of this kind is usually necessary.

The Homestead Garden.

If flowering shrubs are studied it will be noticed that they flower best either on the old wood—or the young wood, that is, one-year-old wood—or the new wood as do roses. On this chiefly the pruning treatment required depends. Early-flowering shrubs of importance that carry their blossom on the young wood such as forsythias, lilacs, double-flowering peaches, Banksia rose, acacia, &c., are greatly benefited by cutting away the wood so soon as flowering is over to admit the light and air which are so necessary to the young growth that follows and is to flower next season. If favourites are given this attention their gratitude will be generously expressed by the enhanced display that will follow. Suckers also should be suppressed, as they represent so much wasted energy, and they, too, interfere in the development of legitimate growth. For this reason all rank superfluous growth inclined to crowd the plants should be suppressed. Rhododendrons rarely make sufficient growth to require much pruning, but it is well worth while removing the seed-pods from heavy-flowering varieties so soon as the petals have fallen.

As the time is arriving for setting out summer bedding-plants some preparation should be made. The fragrant stocks, the glowing zinnias, and the delicately coloured asters each have their appeal, and provide wholesome pleasure when well grown. This is best attained by strictly limiting the area planted and doing it well. The foreground of the shrubbery border so often used is rarely suitable as the interests of the respective crops often seriously clash. As the name bedding-plants indicates, they are best grown in beds or borders specially set aside for the purpose so that the proper treatment may be given. With the continuous cropping these receive there is a danger of them becoming deficient in humus, without which good results cannot be obtained. It may be supplied now by turning in a good supply of decayed farm manure. If 3 oz. or 4 oz. of bonedust to the square yard is included, success should be assured if good plants are set out in a tasteful manner. An ounce or two of superphosphate to the square yard hoed in shortly before planting would supply their more immediate need for phosphates.

Good plants are dwarf, bushy, and well rooted. It is important too they should be well hardened off and not suddenly transferred from the glasshouse or hotbed, which would cause them to become stunted in their growth. Cheap plants are very tempting, and the assurance they will make good is very plausible, but the advice previously given to limit the area and do it well is the best policy.

The "planting-season" during which hardwooded plants generally can be transplanted satisfactorily is now drawing to a close. Where new planting of this kind has been done, it will be sufficient to suppress the growth of weeds and grass in the vicinity that might rob the young plant of its requirements of light and air, and, should the season or locality be dry, a mulch of stable manure or humus about each plant will be of assistance in retaining moisture.

—W. C. Hyde, Horticulturist, Wellington.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

PLANTING TREES ON GORSE LAND.

B. S. H., Cambridge :—

I propose planting an area of gorse land in trees, the gorse is about 6 ft. high, but not particularly dense. Would you please advise me a simple yet efficient way to prepare this land for planting year-old trees ? I presume that so long as the gorse is checked sufficiently to prevent choking out the trees, there will be no need to grub the gorse. The trees will be chiefly varieties of eucalypts.

The Fields Division :—

Eucalyptus will not smother gorse, and the most economical method would be to grub the pest before planting the trees. The eucalypt habit of growth affords ample sunlight to weed pests, consequently they thrive luxuriantly under the trees, requiring periodical cutting, &c. Should you decide to plant the trees amongst the gorse the land requires little preparation. For one-year-old trees a hole about 2 ft. square is ample. Holes should be dug well ahead of planting, so that the soil has as much weathering as possible. A dressing of blood and bone mixed with the soil at the rate of ½ lb. per tree is recommended.

PAMPAS GRASS.

A. V. B., Waitahora, Dannevirke :—

Will you please advise me as to the growing of pampas grass, and where seedlings may be obtained.

The Fields Division :—

Although pampas grass will establish and grow almost anywhere, like all other plants the rate of growth and vigour of the plant varies considerably with the soil and moisture conditions. Pampas grass grows best on rich, moist, drained swamp land, but will also give satisfactory growth on any medium to good farm land, particularly in damp situations, though it does not like water-logged conditions. The plant can be grown from seedlings or from rooted cuttings, from an old plant. As with marram grass, the best cuttings are taken from young two- to three-year-old plants, the side shoots being cut off below ground so that some of the roots are retained on each cutting. Seedlings were at one time supplied by Messrs. A. Yates and Co., Seed and Manure Merchants, Auckland. All plants, whether seedlings or cuttings, should be heeled in in good garden soil, and kept watered until the plants strike. It is necessary for early spring planting, therefore, to have plants on hand about May. Plants obtained in the spring should be kept in the garden and attended to until the following autumn, when they can be put out in permanent position in April or early May. The best time of planting out is in August or early September, and plants should therefore be obtained in the previous autumn. In heeling in or planting out the earth should be packed tightly round the roots and the soil kept moist and loose at the surface, though very firm below. For shelter or fodder pampas is planted in rows 6 ft. apart with 6 ft. between the rows, 1,000 plants being required per acre. It must be well protected from cattle, as continuous grazing will kill even fully grown plants. A certain amount of light cultivation round the plants during establishment and a light dressing of super annually will do much to push the growth forward when once full grown and fit to feed off, which may take anything from two to four–five years, according to soil conditions, &c. The grazing-off of the plants will be followed by a rapid growth sufficient in most cases to give about the same amount of leafage as was on the plants when first fed off. After feeding off, say, in the winter, it is necessary, therefore, to close the area immediately until the following winter. It is best also to feed off if possible in breaks, rather than as a whole. An established and well-grown area of pampas grass would provide a permanent winter-feed reserve for cattle, and could be made of particular value to the sheep-farmer who requires to winter cattle for feed-control purposes in the spring and summer. Pampas grass is also a valuable fodder for wintering dry cows on the dairy-farm.

WEATHER RECORDS: AUGUST, 1937.

Dominion Meteorological Office.

NOTES FOR AUGUST.

AUGUST is normally regarded as the last month of winter, but that just past was mild, pleasant, and distinctly spring-like in character. The cold of the early winter caused a shortage of pasture in many districts during the first part of the month, and it was necessary to resort to hand-feeding of stock. The dry weather accentuated this condition. In addition to pastures, the wheat crops in mid-Canterbury and North Otago suffered considerably, and mild rains are badly wanted there and at some other localities. Over most of the country, however, there was fairly rapid growth of vegetation during the latter half of the month, and stock have kept in fair condition. The weather was favourable for lambing, and the losses have been relatively light.

Rainfall.—The month was a particularly dry one over most of the Dominion. The greatest defects from normal rainfall occurred in the southern half of the North Island and the eastern area of the South. In some places it was the driest August ever experienced. In parts of eastern North Auckland, in the Bay of Plenty, and in the Gisborne area, however, the average was exceeded.

Temperature.—At a few places in North Auckland and in Hawke's Bay the mean temperature was slightly below normal, but over the remainder of the country the normal was exceeded. The departure was in the vicinity of 0°·5 in the North Island, but greater in the South, and at places in the western and far southern districts it exceeded 2°.

Sunshine.—There was a prevalence of cloudy weather, and the amount of bright sunshine recorded fell below the average for August, the deficiency being greatest in the eastern districts of the South Island.

Pressure Systems.—One storm system alone during the month caused generally disturbed conditions. This was a deep depression of the westerly type which passed between the 3rd and the 7th. Strong winds and fairly general rains occurred during this period, the worst effects being experienced on the night of the 6th and on the 7th, when a severe south-westerly gale blew in most districts, with hail and snow in places. By the 8th the front of an anticyclone had extended on to the Dominion, and from then until the 26th pressure remained high.

An intense cyclonic depression, which was located off the New South Wales coast on the 21st, moved very slowly across the Tasman Sea during the next few days, and from the 23rd to the 27th was responsible for north-east winds and mild, dull, misty weather in the Dominion, with scattered rains. The latter were mostly light, but some heavy falls occurred at places in North Auckland and on the east coast of the North Island. By the 27th, when it had at last crossed the Dominion, the cyclone had become a very shallow one, and the southerly which was associated with its rear was very mild.

Anticyclonic conditions and fine weather again ruled on the 28th and 29th, but on the latter day a fresh cyclonic depression formed to the north-west of New Zealand. This moved slowly, at first, in a south-easterly and later in an easterly direction, passing Cape Maria van Diemen to the northward on the 30th. Dull and misty weather prevailed over most of the country. Gales from between east and south-east blew in the northern and eastern portions of the North Island on the 30th and 31st, accompanied in many places by heavy rain. In the Bay of Plenty some flooding occurred.

RAINFALLS FOR AUGUST, 1937, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average August Fall.	Total Rainfall to Date.	Average Rainfall to Date.
North Island.						
Kaitaia	2·48	10	0·78	5·12	44·34	38·76
Russell	13·97	15	5·85	5·52	82·25	42·86
Whangarei	9·39	20	3·42	6·31	66·77	45·10
Auckland	1·53	13	0·40	4·61	31·75	34·47
Hamilton	2·03	8	1·25	4·11	28·36	33·11
Rotorua	2·14	5	1·03	4·91	33·02	36·76
Kawhia	1·08	6	0·40	4·63	25·10	36·18
New Plymouth ..	1·54	7	0·65	5·49	40·13	40·41
Riversdale, Inglewood ..	2·52	9	1·17	8·89	63·07	67·60
Whangamomona ..	0·47	3	0·24	6·02	46·16	48·99
Hawera	0·87	7	0·23	4·50	27·49	30·11
Tairua	3·06	13	1·13	5·84	40·54	45·71
Tauranga	4·66	11	2·88	4·30	38·34	36·12
Maraehako Station, Opotiki	3·49	8	1·58	5·48	43·51	37·73
Gisborne	6·92	14	2·24	4·33	29·66	34·29
Taupo	0·99	6	0·57	4·07	21·59	29·30
Napier	1·98	10	0·95	2·95	16·82	22·30
Hastings	2·25	10	1·06	3·15	13·69	23·42
Taihape	0·57	8	0·36	2·74	20·59	23·52
Masterton	1·75	13	0·55	3·59	22·81	26·54
Patea	0·85	7	0·28	3·81	28·01	29·44
Wanganui	0·82	6	0·32	2·81	21·13	23·85
Foxton	1·42	4	0·77	2·95	15·32	21·33
Wellington	1·03	8	0·31	3·93	23·62	29·67
South Island.						
Westport	3·00	7	1·29	7·70	53·64	62·50
Greymouth	2·39	14	0·70	7·48	66·72	64·97
Hokitika	5·29	12	1·21	9·24	72·19	73·29
Ross	8·36	12	2·20	10·43	85·65	82·38
Arthur's Pass ..	2·96	8	0·84	10·20	92·14	96·07
Okuru, South Westland	7·82	6	2·24	11·24	99·12	93·80
Collingwood	2·36	5	0·98	7·11	56·18	62·09
Nelson	1·89	7	0·76	3·06	23·90	24·86
Spring Creek, Blenheim	1·58	8	0·75	2·75	17·53	20·64
Seddon	2·40	9	1·43	1·90	16·42	16·62
Hanmer Springs ..	1·00	8	0·26	3·42	21·32	29·48
Highfield, Waiau ..	1·10	5	0·75	2·45	14·57	22·53
Gore Bay	2·02	6	1·30	2·64	22·28	21·31
Christchurch	1·76	11	0·83	1·82	16·47	16·99
Timaru	1·01	8	0·57	1·45	14·61	14·43
Lambrook Station, Fairlie	0·51	5	0·20	1·53	12·81	16·13
Benmore Station, Clearburn	0·97	7	0·27	1·48	18·57	16·02
Oamaru	0·76	9	0·15	1·74	11·25	14·44
Queenstown	1·05	6	0·62	2·05	19·72	19·43
Clyde	0·76	4	0·35	0·79	11·13	9·45
Dunedin	1·90	14	0·63	3·07	30·06	24·13
Wendon	1·77	10	0·40	2·05	31·11	19·27
Balclutha	1·33	10	0·36	1·78	24·51	16·27
Invercargill	1·99	17	0·44	3·20	30·30	29·78
Puysegur Point ..	5·16	21	1·28	6·94	61·39	55·35
Half-moon Bay ..	2·15	15	0·57	4·39	42·18	37·92